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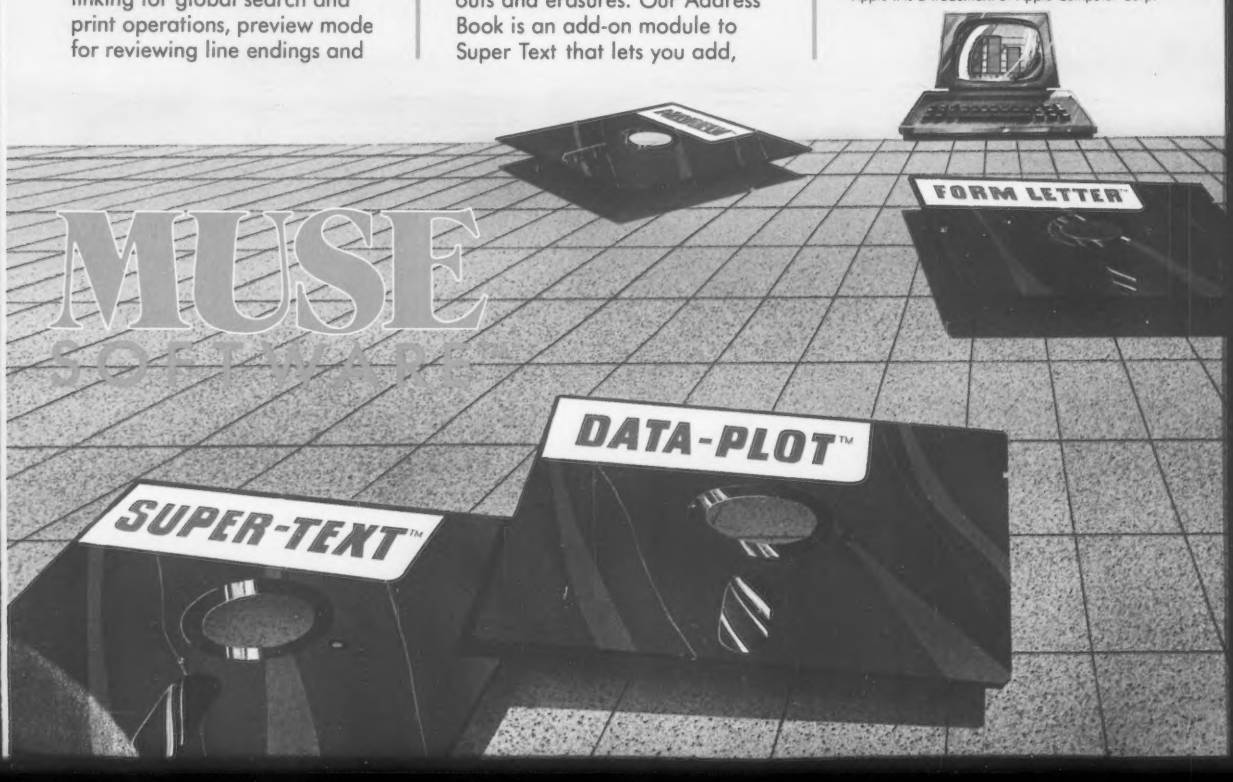

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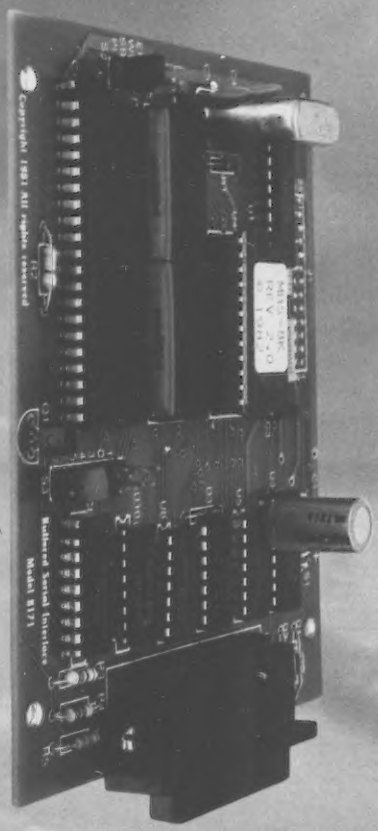

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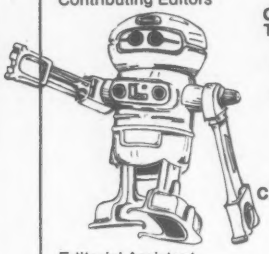

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Video Artists

Attention video artists and film producers.

If you have been reading *Creative Computing* lately you know that we are most enthusiastic about optical laser scan videodiscs. We are fascinated about the possibilities when these discs are used interactively with computers. In the January issue, for example, we described a game which uses visual sequences from a videodisc. The cost of mastering and producing such disks is coming down dramatically. Hence, we are looking to produce a videodisc for several different uses.

1. **Visual adventure games.** The adventure game we wrote using the commercially available disc of *Rollercoaster* was agonizingly slow because of the time needed to search for visual sequences, some of which might have been at the beginning of the disk and some at the end. If the sequences are close to each other, the search can be performed very quickly. Hence, what I am looking for are 10-20 second action sequences over a wide variety of subject areas. For example, getting on a bus, an airplane landing, people walking down the street, opening a door, a ride at an amusement park, eating a hamburger, lighting a cigarette, hammering a nail, opening a cupboard, pouring a cup of coffee, diving in a pool, digging on a beach, etc. What I am seeking is hundreds (maybe thousands) of everyday and not-so-everyday scenes which can be put on a videodisc and worked into a wide variety of adventure games. The material cannot be copyrighted or covered by Screen Actor Guild contracts since it will be used in highly interactive and, perhaps unexpected ways. Since this will occupy only a small fraction of the disk, I am also looking for:

2. **Computer and video graphics.** At Siggraph, NCC, and other computer conferences frequently one or more computer graphic artists shows a short film or videotape of his work. Some of these are incredibly spectacular. However, I have rarely seen one long enough to be released on its own since there is really no appropriate format to distribute extremely short subjects. However, now we have the appropriate vehicle. Imagine, if you will, 20 or 30 exciting, dynamic video graphic sequences which can be viewed individually or as a group. We would incorporate music with this to make it an exciting visual and aural experience.

For previewing the material, we would prefer that it be submitted on one of the two home videotape formats, Beta (II or III) or VHS. All tapes will be returned. The final videodisc will be produced using professional equipment, however, we'd like to rough it out with home (read, low-cost) equipment.

Please address your submissions to Videodisc Project, Creative Computing, 39 East Hanover Ave., Morris Plains, NJ 07950.

Down Under

Have you ever thought about going down under?

Here's a golden opportunity. The Ninth Australian Computer Conference together with a Schools Symposium is being held in Hobart, Tasmania, Australia from August 23-28 1982. Tasmania is an island state in the southernmost part of Australia and, despite the unsavory reputation of the not very pleasant Tasmanian Devil, the residents feel that it is the best and most hospitable part of Australia.

The theme of the conference is "Native Technology." The intention is to focus on the possibilities that exist for encouraging indigenous technology in countries like Australia and solving their related problems. The scope of the conference is broad, having such diverse streams as auditing, computer crime, computers in medicine, robotics and industrial use, databases, computers in government, networks and communication, and the software industry. The concurrent Schools Symposium will bring together both international and Australian lectures in presentations and small discussion groups with students and teachers.

Tasmania is one of the most advanced states in Australia in developing computer education in schools, and can be classed with world leaders in this respect. Its statewide network has brought computing to remote rural areas and participation by students and their teachers, along with people from other parts of Australia and overseas, is sure to make this symposium a lively event.

Keynote speakers include Dr. Seymour Papert from the LOGO project at MIT; Professor Tom Stonier from the University of Bradford and author of *A Wealth of Information*; Ted Codd of IBM Advanced Research in San Jose, known internationally for his work which led to the concept of relational databases; and yours truly, who will be talking about videodiscs, computers in education, and several other topics.

The social events in conjunction with the conference sound quite spectacular. A full day excursion will visit Eaglehawk Neck and Doo Town, Devil's Kitchen and the Blowhole. It includes a guided tour of a ruined prison, a visit to a 19th century steam operated timber mill and a cray-bake and barbecue. There are bush ventures which are four-wheel drive tours designed to show the southwest sections of Tasmania not usually seen by tourists. Each four-wheel drive vehicle will have six or fewer passengers and the itinerary will be set in accordance with the interests of those on board. Thursday boasts a "bush ranger night" with an ox roast on the village green followed by a country dance in the village hall in Richmond. There are also several other cruises, dances, and other social events.

For more information, write Ninth Australian Computer Conference, P.O. Box 216, Sandy Bay 7005, Tasmania, Australia.—DHA

Siggraph Correction

Ikonas Graphics Systems has notified us of a correction for our "Smoothers of the Lost Arc" report on Siggraph '81 (March 1982).

The Mountain Scene, Photo 2 on page 104, was computed by Loren Carpenter while he was with the Boeing Company. The mountain images were first shown at Siggraph '80 in Seattle.

Siggraph '82

The Ninth Annual Conference on Computer Graphics and Interactive Techniques will be held in Hynes Auditorium, Boston, MA on July 26-30, 1982.

This computer graphics conference is sponsored by the Association for Computing Machinery Special Interest Group on Computer Graphics (ACM SIGGRAPH).

The conference program will feature display exhibits, courses, technical sessions, vendor forums, a multi-media computer graphics art show, and computer-generated films.

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input/output

Who's Afraid?

Dear Editor:

The article by Keith Brewster, "Who's Afraid of the Big, Bad Matrix?" (December 1981) deals with a topic difficult for the neophyte to understand. Brewster's concept of an array (and a matrix) as a collection of numbered boxes is a useful one for helping the beginner understand arrays.

For the most part the article is good, but I take exception to his definitions of the terms array and matrix. These are incorrect and would lead to confusion as the neophyte graduates to a learner who wishes to read other sources. The other sources would not use Brewster's definitions.

Technically, an array is an indexed collection of variables. Thus, the term array is general and applies not only to the one-dimensional case, but to the two-, three-, ..., and n-dimensional array as a "list" and a two-dimensional array as a "table." These two terms give him a visual image of these two types of arrays. A one-dimensional array is a numbered list of variables, e.g., A (1), A (2), ..., A (15). A two-dimensional array is a numbered (i.e., indexed) table of variables:

A(1,1)	A(1,2)	A(1,3)
A(2,1)	A(2,2)	A(2,3)

A table has rows and columns.

Where does the term matrix fit in this? A matrix is another name for a two-dimensional array. It is *not* two-, three-, ..., n-dimensional as Brewster states. Thus, matrix and table are synonymous and a matrix has rows and columns. To be absolutely correct, a matrix is two-dimensional having rows and columns, but it may have only one row or only one column. This means that we may properly call a one-dimensional array a matrix. (Tables can have only one row or one column, can't they?)

What would I tell the beginner about arrays? An array is a set of variables, all with the same name, which are numbered, or indexed, so we can identify each. A list is one type of array, a list of variables. A matrix is another type of array, a table of variables.

We can think of each as a set of boxes in which the boxes are identified by a number or a pair of numbers (to indicate the row and column in a matrix). We can store either numbers or strings in these boxes, depending on the type of variable name we choose, either numeric (A) or string (A$).

I find that this explanation works well with my students in Basic programming classes.

Dr. Elton Beougher, Chairman
Department of Mathematics
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Hays, KS 67601

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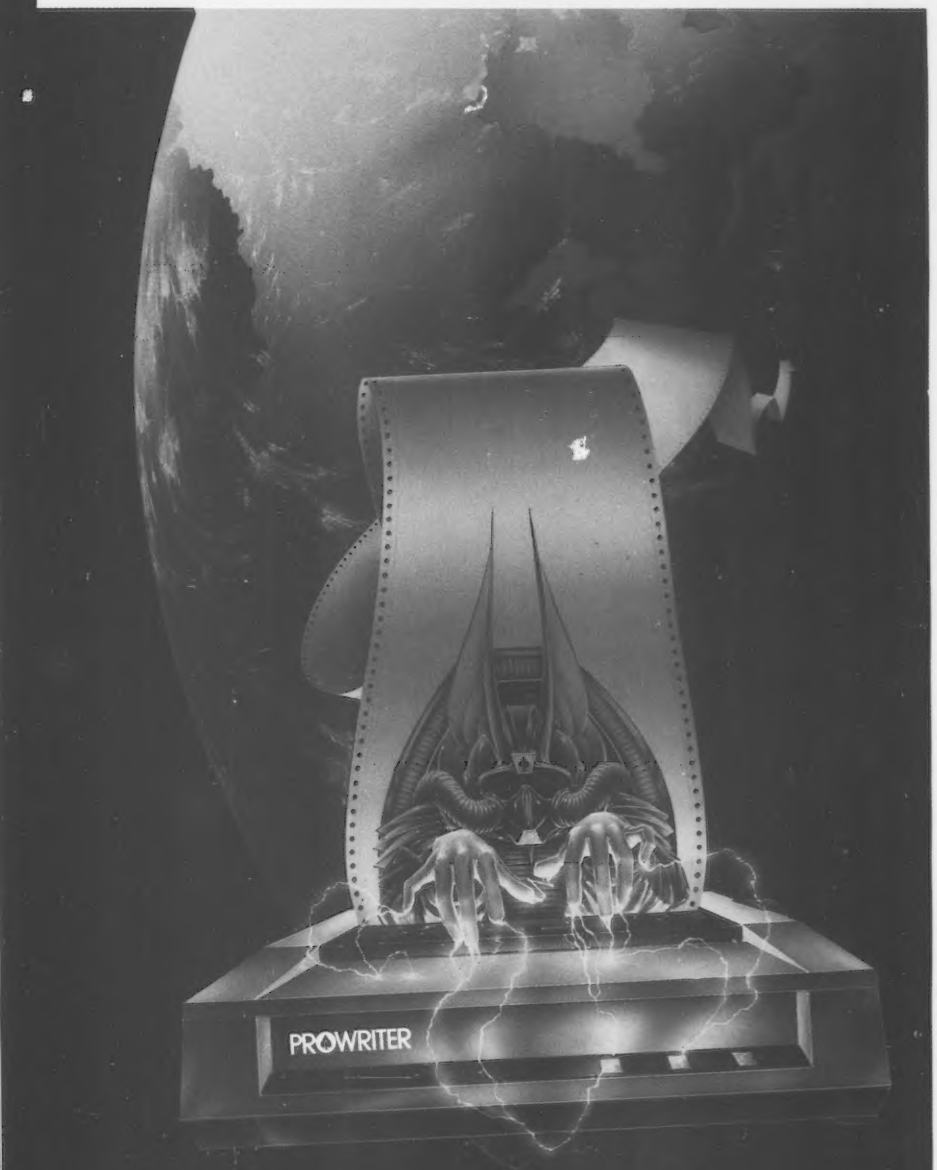

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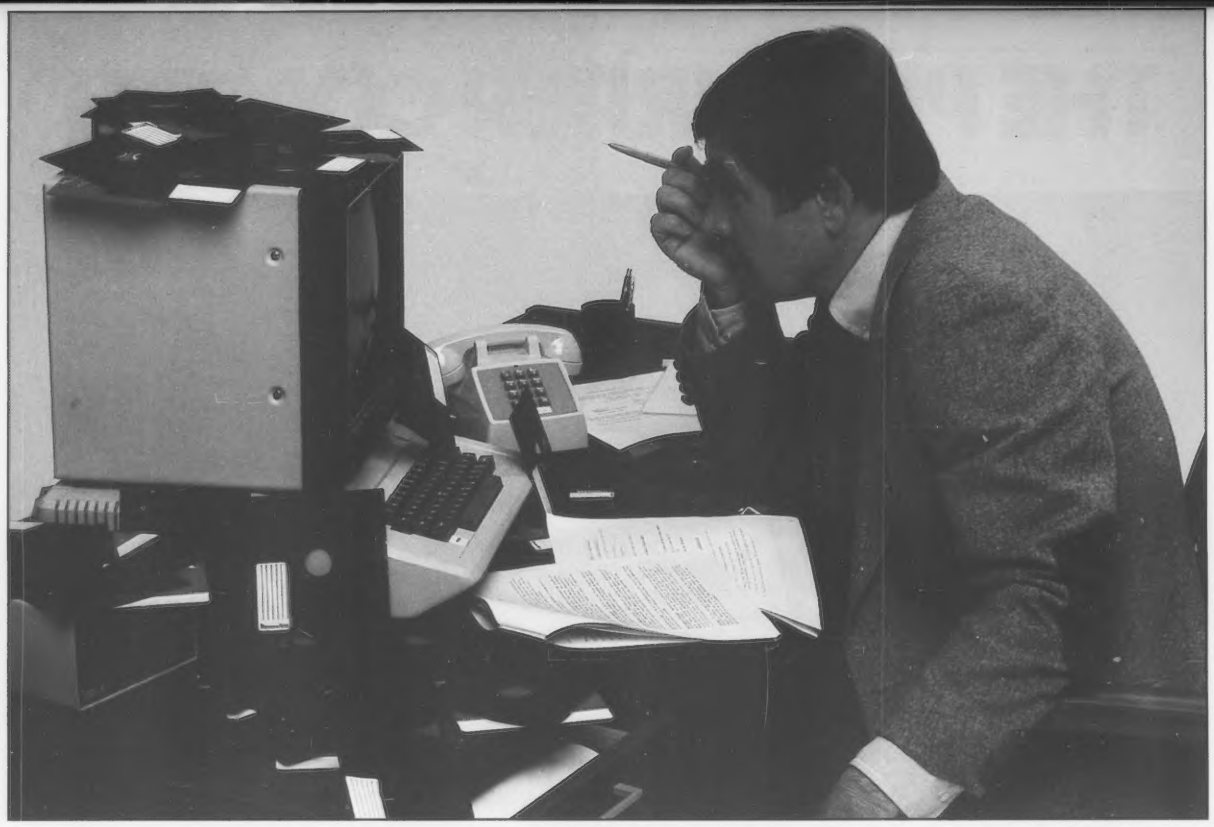

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creative computing equipment evaluation

The Little Computer That Could

Glenn A. Hart

The computer business is very much a land of opportunity. Major advances in technology arrive with startling rapidity. Combined with tremendous demand in both the consumer and business sectors, the result is an alluring siren that draws a large number of new ventures.

There are so many such companies that there is even a jargon word for them: "start-ups." There is just the slightest touch of skepticism implied in the phrase; many, if not most, such operations announce exciting new products but ultimately can't deliver any at all or quickly fail through under-capitalization, design problems or simple mismanagement.

When Adam Osborne, a transplanted Englishman known primarily as a writer and industry pundit, announced his own start-up hardware firm to produce a full-featured portable CP/M computer with an impressive array of software at an unbelievable retail price, it is an understatement to say that there were a few doubters.

As we'll see, Osborne has delivered everything he promised and then some. The result is an excellent and different computer, an impressively well-run company with unique policies and fine prospects for the future.

The Osborne I doesn't offer any real revolutionary breakthroughs. It is much more an evolution and refinement of existing techniques used elsewhere, packaged in a very new way.

Glenn A. Hart, 51 Church Road, Monsey, NY 10901.

It employs a standard Z-80 microprocessor, 64K of dynamic RAM, various I/O for peripherals, a video monitor, and two 5 1/4" floppy disk drives. These specifications could easily describe many microcomputers, although in each area there are little wrinkles of sophistication which we will examine shortly.

The 5" monitor is clearly the most controversial aspect of the machine.

The remarkable thing is that all this is completely portable! A very sturdy molded plastic case that is a dead ringer for a portable sewing machine houses everything mentioned above. When the case is sealed it is weather resistant and sized to fit under an airline seat. Releasing two latches opens the case, allowing the main unit to sit on the edge of the keyboard to form a compact and neat work station.

The full-sized keyboard has a more or less standard layout with a numeric keypad and a few extra keys for cursor movement and other special functions. Feel is quite good, better than many microcomputers, although not quite up to some expensive stand alone terminals.

The Osborne uses what they refer to as three banks of memory, although these are not the normal banks used in some S-100 systems. The first bank is the normal 64K of dynamic RAM. The top 4K is used for memory-mapped video display, leaving 60K for the CP/M BIOS and BDOS/CCP. Memory mapping provides very fast screen update and allows direct manipulation of screen characters with some sacrifice of memory space.

The second bank holds 4K of ROM which takes control when the system is first turned on. The ROM contains disk booting routines, diagnostics, and I/O. video, disk, keyboard and port drivers. The code in the ROM is something of an extension to CP/M; some of the code which would normally be in the CP/M software is stored in ROM instead.

Also in bank 2 is the memory-mapped I/O area. Almost all normal CP/M systems use what is called port-mapped I/O, meaning that information is passed to and from devices through one of the 256 input/output ports supported by an 8080 or Z-80. The Osborne uses chips from the 6800 family (specifically a 6850 and a 6821) which require that data be written to memory locations instead of to I/O ports. This may seem rather strange to CP/M types, but S-50 users will feel right at home.

The balance of the second memory bank mirrors or shadows the base bank and therefore isn't available for any constructive use. The third bank is unused except for the top 4K. One bit of each byte in this area is used as a video attribute to control underlining of each character.

Video Display

Video is displayed on the 5" monitor, which is clearly the most controversial aspect of the machine. Unlike most serious

monitors, which usually display 24 lines of 80 characters each, the Osborne screen shows 24 lines of only 52 characters each. This is thirty-five percent fewer characters than you would find on a standard screen, but over 20% more than the 16 x 64 screens still used on some computers and much more than an Apple II and other small computers which use TV sets as their display media.

The characters are very sharp and well defined, with full upper and lower case with descenders. The only deviation from a normal font is the lower case m, which is a smaller version of an uppercase letter to avoid blurring.

The Osborne I actually maintains a much larger 32 line by 128 character video area in internal memory; the hardware permits scrolling around in this area with the cursor movement keys in some modes of operation.

Full underlining and half intensity are available, as are 32 block graphics characters useful in forms design. A connector on the computer can drive an external video monitor of any size, which certainly eliminates the small screen size problem but also destroys the portability advantages which are the Osborne's main claim to fame. The external monitor displays exactly the same 24 by 52 format of the built-in screen.

The two built-in disk drives are another source of dispute. While they work perfectly and are quiet and reliable, disk capacity is limited to only 102 kilobytes each, and of this only 92K is available for program and/or data storage under CP/M. This is sufficient for a surprising amount of serious work, but many CP/M applications require far more storage capacity.

Interfacing

The Osborne I really shines in interfacing provisions. A standard RS-232 serial port is provided which can run at 300 or 1200 baud (600 or 2400 with an internal jumper change). The supplied software implements several handshaking protocols if necessary, including ETX/ACK, XON/XOFF, etc. This port is fully bi-directional and can also be used to interface an external console, transfer programs and data to an external computer, etc.

A separate modem port, which uses a nine-pin connector, is provided. Osborne will be releasing a custom modem designed to use this port, but it is not difficult to configure a normal acoustic or direct connect modem to match the Osborne I.

A full IEEE 488 port is also included, which is most unusual indeed. This port can be configured to provide the standard Centronics parallel printer protocol as well, so almost any type of printer can be accommodated. There is a wide variety of devices which have been interfaced to the IEEE bus, including hard disks, modems, printers and laboratory equipment, so the ability of the Osborne to interface with the outside world is essentially unlimited.

The final connector is for a forthcoming battery pack which will allow the computer to operate up to two hours without any access to AC power. A car adapter will also be included to run the unit from an auto battery.

The combined hardware/software of the Osborne I is a bargain.

Software

The Osborne I is, indeed, supplied with the wealth of software claimed. It is hard to believe that such a comprehensive assortment can be provided at the price of the total package; the combined list prices of the software are reasonably close to the Osborne's retail price of $1795. It is almost like getting the computer free! Of course the software included is available at significant discounts, but the combined hardware/software of the Osborne I is, nevertheless, a bargain.

The computer is supplied with a complete implementation of CP/M version 2. All the standard utilities are provided, including ASM, ED, MOVCPM, PIP, STAT, FORMAT, etc. Unfortunately, Osborne does not include a listing of the BIOS, so user modifications and patches are difficult or impossible.

Osborne has announced a technical manual which will include the BIOS listing. As partial compensation, an excellent setup utility is provided which automatically configures the BIOS for the type of printer drivers desired, baud rates and other parameters. The program allows assigning strings to the number keys 0 through 9 such that a control-1, for example, will output whatever string the user has preprogrammed for that key. Thus the Osborne computer has an even more flexible function key design than terminals with actual function keys.

The FORMAT program also serves as a full disk fast copy utility, and features a very good screen display to let the user know what is happening as formatting or copying proceeds.

When the CP/M disk is booted, an excellent help menu appears rather than CP/M itself (see Figure 1). Selecting a letter displays a screen of explanatory text describing a machine feature or giving instructions on the purpose and operation of software. This is a great help to first time users.

The commercial programs are the Microsoft Basic interpreter, the CBasic pseudo-compiler, Sorcim's excellent Supercalc spread sheet program and WordStar with MailMerge for word processing.

The Basics are the current versions and are not customized for the Osborne in any way.

Supercalc has been partially configured for the Osborne; some messages don't fit the screen window.

The WordStar provided is version 2.26 rather than the new 3.0. This is due to a conflict in the horizontal scrolling provision of WordStar 3.0 with the routines built in to the Osborne's hardware. Since the only

Figure 1.

```
                        Initial Help Menu

press A...CP/M Assembler        N...MailMerge
      B...CBASIC                O...Osborne Utilities
      C...CP/M Commands         P...Printers/Printing
      D...Diskette Handling     Q...Quitting Each Day
      E...File Extensions       R...The RESET Button
      F...Filenames             S...SuperCalc
      G...Graphics              T...Testing
      H...Programming Hints     U...CP/M Utilities
      I...I/O Ports             V...External Video
      J...Just Starting?        W...WordStar
      K...Control Keys          X...Accessories
      L...Layout of Memory      Y...Modem Connection
      M...Microsoft BASIC       Z...Self Portrait

Press any LETTER key to receive help on a subject.
Press the ESCAPE key (labeled "ESC") to run CP/M.
```

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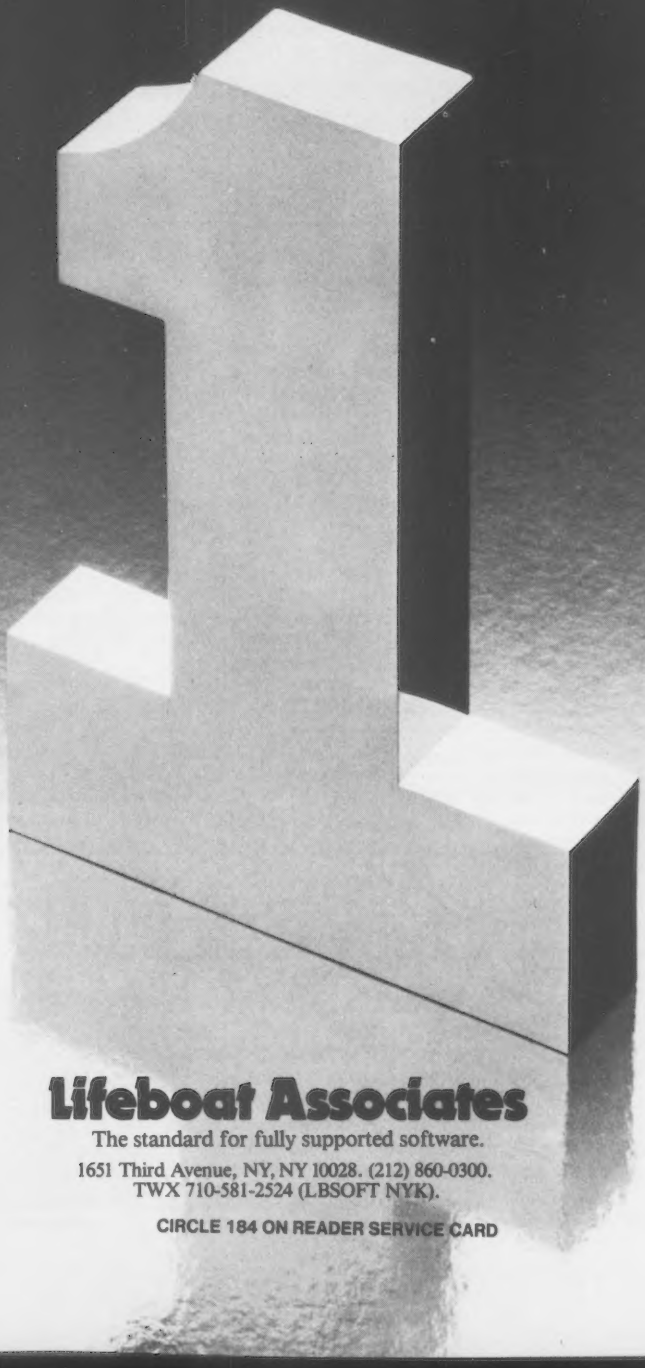

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other important new feature in 3.0 is block operations on column groups rather than lines of text, the 3.0 may be provided in the future after some software modifications.

All the software is first rate and works perfectly on the Osborne. With the limited storage capacity of the floppy disks, WordStar consumes most of a disk and some of the other packages eat up a lot of disk space as well. All this means is that the program disks almost always use the left drive while user files and applications use the right one. There is ample room for many applications, although WordStar users must be quite careful in monitoring the size of their files.

Company Policies

Any new computer almost certainly has some design problems and bugs. The Osborne was no exception, although most of the problems were relatively minor. What is exceptional is the approach Osborne took in the past and continues to take to solve problems and improve the performance of their system.

When the normal difficulties arose with early units, Osborne made arrangements to make *free* upgrades to the keyboard, ROMs and software. Users merely had to bring their units to a dealer for no charge replacement and upgrade.

This is quite unusual, with most companies offering improvements at perhaps a lower cost than normal, but almost always charging for such major upgrades. Similarly, documentation upgrades are being provided at no charge to all registered owners.

Speaking of documentation, the Osborne I deserves special commendation in this area. The computer is supplied with very comprehensive explanations of its internal hardware and software design, including all the pinouts for the interface connectors and complete software examples on how to access video and I/O memory addresses, how to drive the interfaces and many other useful and informative tidbits of information.

Complete documentation for all the applications software is also provided; in some cases this closely mirrors that provided by the software authors, while some of the manuals have been rewritten by Osborne.

While the original documentation was very good, Osborne wasn't completely satisfied. They hired one of the best microcomputer writers around, Thom Hogan, to rewrite everything. The new version is even better and more informative, and maintains a nicely conversational tone even while discussing highly technical subjects. Both tutorial and reference sections are provided, for a total of more than over 500 pages.

Osborne's marketing philosophy aims the Model I at business executives and other non-technical types. This explains their omission of the BIOS code in the documentation provided to all users; they prefer to produce relatively "turn-key" systems which can be field configured by users or, at worst, by their dealers.

Osborne is making arrangements with various software houses for Osborne itself to market many desirable software packages directly, allowing the company to maintain full control over the hardware/software interface. While outside vendors have already begun to market software for the Osborne I, few hardware companies have made peripherals available as yet.

Osborne's marketing philosophy aims the Model I at business executives and other non-technical types.

Osborne will be addressing some of the shortcomings of the machine in the near future. A double density upgrade is due for release around the time you read this article. This modification will permit 200K to be stored on each drive at a cost of around $200 for the dealer installed retrofit. There are many 5 1/4" drives which store much more than this, usually through a combination of higher track density and/or double sided drives, but Osborne states that such mechanisms do not yet meet their standards of reliability, especially with the jostling a portable unit receives.

"We have a computerized toilet, and it's really nice—unless you have to go and the computer is down!..."

Work is also proceeding on a 24 by 80 video presentation. This upgrade will involve a complete swap of the single board computer and will also include the double density option and expanded communication capabilities at a cost of approximately $600.

Other new products include the battery pack/car adapter mentioned earlier and a full-function 300-baud modem which will fit in the disk storage compartment and require some internal modifications. Cost for the battery pack will be about $225, including communication software.

Evaluation

I have a bit of a confession to make. When *Creative Computing* called to ask me to review the Osborne I, I was rather reluctant to do so. My personal system lists for about $30,000 and includes large capacity hard disk, three printers, plotting, many sophisticated special purpose boards and many other goodies.

I fully expected to feel constrained by the limitations of the portable unit. I had heard of the difficulties some users had with the small screen size and limited disk capacity and, all in all, I wasn't sure I could provide an objective evaluation of the unit.

Well, my actual reaction is just about completely the opposite. The little Osborne I has won me over almost completely. Besides being immensely "cute" and a real startler to those who see it for the first time, the unit has worked flawlessly and done everything it claims to do.

I have lugged it around to friends' houses, taken it on weekend trips and, more important, carried it back and forth to work. It worked perfectly the first time in driving several different printers with differing interface and protocol requirements, allowing me to use it for word processing and spread sheet forecasting.

I am certainly not blind to its limitations, but I have been able to perform a tremendous amount of useful work on the Osborne I which would otherwise have been difficult or impossible under certain circumstances. It is a very useful extension of my big system, and will be even more so when some of the new upgrades and peripherals become available.

In many respects, I think the Osborne I is a far more capable computer than many of the small micros widely used today, even without color graphics and the other bells and whistles available on some other units.

As either the primary computer for business executives or as a second computer for CP/M users, the Osborne I is a fine choice. The only problem I have now is that *Creative* thinks I'm giving the Osborne I back to them. No way! They'll have to come and drag it away from me! □

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ALONE IN AN UNCHARTED GALAXY, YOU'RE SUDDENLY AMBUSHED BY AN ALIEN MARAUDER. INSTINCTIVELY, YOU FIRE YOUR LASERS. HITTING THE ATTACKER, YOU WATCH IN HORROR AS IT SPLITS INTO TWO MENACING CRAFT. YOU GROW DESPERATE AS MORE ALIENS CAREEN TOWARDS YOU..

by Peter Fokos

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Available at finer computer stores everywhere. *Apple is a trademark of Apple Computer, Inc.

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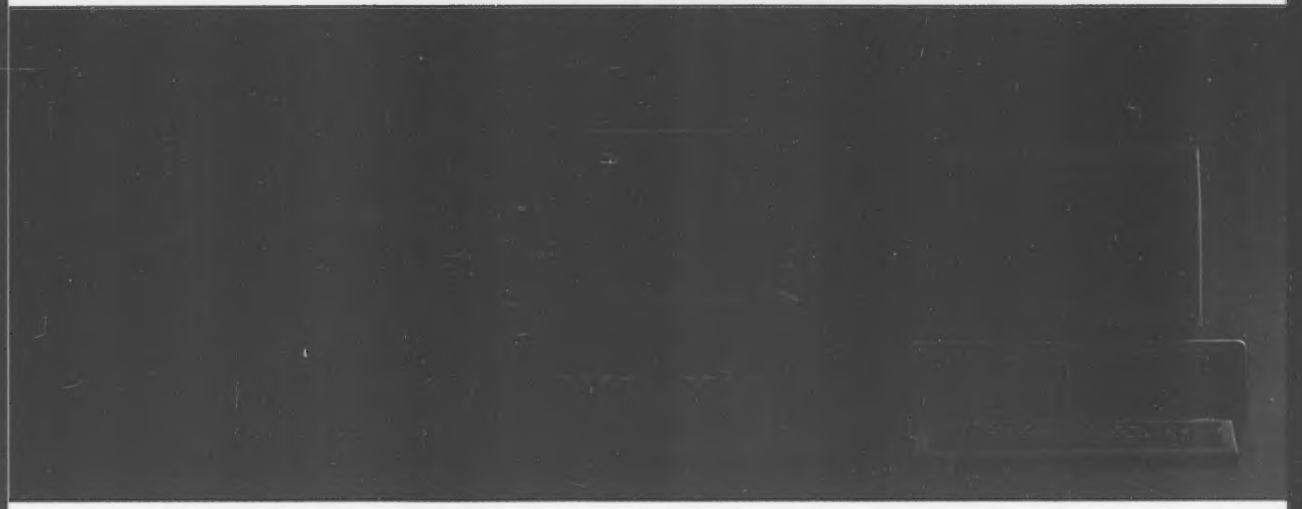

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Xerox 820	Hewlett-Packard 125—Model 10	IBM Personal Computer	Apple III
Standard Memory			
64K	64K	64K	128K
*Maximum Memory when fully configured**			
64K	64K	192K	256K
Expandability			
No expansion slots	No expansion slots	No extra expansion slots in fully configured* 192K system	4 extra expansion slots in fully configured 256K system*
Diskette Storage (per drive)			
92K	256K	160K	140K
Mass Storage (per drive)			
–	4 megabyte Hard Disk	–	5 megabyte Hard Disk
Display Graphics Capability			
High resolution B/W	High resolution B/W	High resolution B/W or 4-color (color requires additional card)	High resolution B/W or 16-color
Software Available			
Word Processing Super Calc® – Communications – CP/M® library	Word Processing VisiCalc® 125 Business Graphics Communications – CP/M® library	Word Processing VisiCalc® – Communications – CP/M® 86 programs	Word Processing VisiCalc® III Business Graphics Communications Apple II software library CP/M® library (available Spring, 1982)

*"Fully configured" means system includes, at minimum, monitor, printer, 2-disk drives and RS-232 communicator. NOTE: Chart based on manufacturer's information available as of December, 1981.

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ProFile™ is Apple's new personal mass storage system—a quick, quiet 5MB hard disk ideal for software development or any mass storage application. Shown above twixt monitor and console, it comes with everything you need to get up and running, including interface card and driver software.

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Plus, soon, a CP/M® card to access that other vast library.

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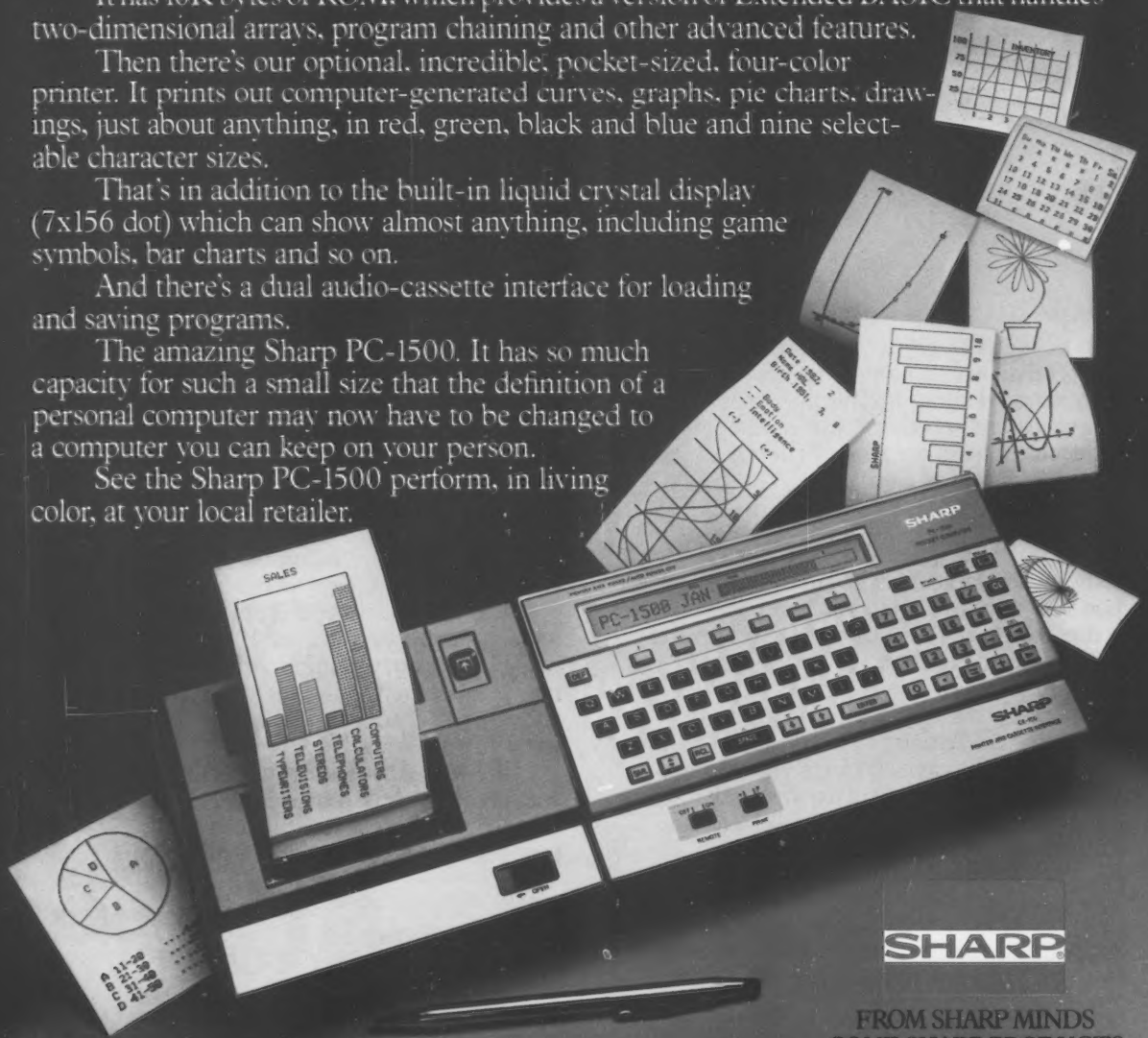

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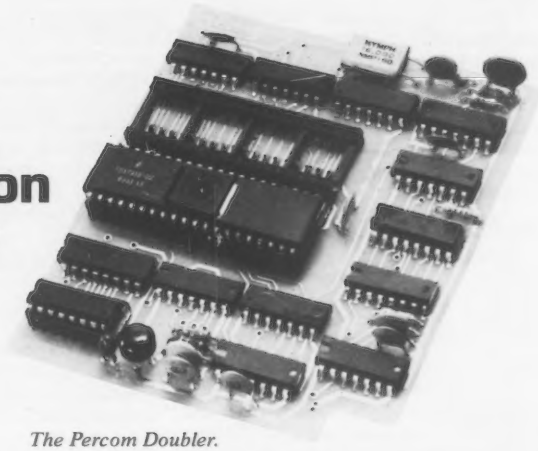
A Winning Combination for Double Density on the TRS-80



The Percom Doubler.

Ronald H. Bobo

Apparently, the amount of software in one's possession expands to fill the storage media available. As the proud possessor of over 70 disks full of software, I recently decided that the time had come to make some changes.

As the owner of a TRS-80 Model I, I had three choices for storage: tape, floppy disks or hard disk. Since I was already using a pair of mini-floppies, and hard disk drives were out of my price range, another solution was needed.

That solution turned out to be a double-density disk controller.

Without getting technical, I will say that double density pertains not to the number of tracks on a disk but, rather, to the way those tracks are formatted and the manner in which information is recorded on them. Whether you now run a 35, 40, 77 or 80 track drive makes no difference; after adding double density, the number of tracks will remain the same, but more data will be packed into those tracks. Actually, the disk capacity is not really doubled; an increase of about 70% is what should be expected.

After reading advertisements for the Doubler from the Percom Data Company of Garland, TX, I bought one from my local dealer. The cost for the complete package, which also contains a disk operating system, was $219.95.

Ronald H. Bobo, 3246 Gravois, St. Louis, MO 63118.

The Doubler consists of a small printed circuit board containing a double-density controller and supporting chips, including an external data separator. The data separator corrects a design deficiency in the TRS-80 Model I which leads to CRC errors and locked out tracks when formatting the innermost tracks of disk.

The board also contains one empty 40-pin IC socket. Installation is simple and well documented. Simply remove the bottom cover from the expansion interface and locate the existing disk controller chip.

Installation is simple and well documented.

Carefully remove this from its socket and install it in the empty socket on the Doubler board, taking care that Pin 1 (on the end with the notch) faces in the same direction as the other 40-pin chip. Now, plug the board into the socket in the interface, again making sure the orientation is correct.

A word of caution: if your expansion interface is still in warranty, opening it will void that warranty.

On bootup, the controller determines whether the disk is single or double density and automatically selects the correct mode. As with nearly everything, there is an exception to this, the LDOS operating system, which will be covered later.

The LNDoubler

LNW Research of Irvine, CA, also manufactures a double density controller. The LNDoubler is priced at $175 and includes a copy of the DOSPLUS 3.3D operating system from Micro Systems Software.

Micro Systems Software has run full-page ads in most of the computer magazines offering a reward of $100 to anyone who finds a bug in the system. I can attest to the fact that this is a bonafide offer, since I found one! I reported it by phone, and several days later received a check. The bug, of course, has now been fixed.

Reports from owners of two different systems using the LNDoubler indicate that it will format some disks which have been rejected by the Percom unit. The LNW unit also has an onboard data separator.

Percom Upgrade

Shortly after hearing the good reports on the LNDoubler, I heard a rumor that Percom was doing a complete redesign on their unit. I made a hurried long distance call to the company, explained that I was doing an article on double density and asked about the rumor. I got a quick denial.

About two weeks later, the person who had denied knowledge of any redesign sent me a packet of literature and a press release on the Percom Doubler II.

Owners of the original version, said Percom, could receive an upgrade kit by sending in $30 and proof of purchase. The

complete unit, at this writing, is selling for $169.95.

The upgrade kit consists of a complete circuit board with everything in place except the disk controller chips, which are removed from the original board and re-used in the upgrade.

I must say it is a great improvement. Since installing it, I have been able to format many disks which were previously rejected.

Simply installing a double density controller is not enough to get rolling; you must also have a disk operating system capable of operating in double density for formatting, I/O etc.

DBLDOS

Percom's Doubler comes with a disk containing DBLDOS. For many months, DBLDOS and OS-80 (also from Percom) were the only double-density operating systems available for the Model I. Others are now available.

DBLDOS is a bare-bones system. Apparently similar to both TRSDOS 2.1 and NEWDOS+, it is adequate for getting started, but most people will probably wish to upgrade to a more powerful system.

Although DBLDOS has provisions for transferring programs between single- and double-density disks, it cannot read a single-density directory. When you begin to transfer your files to double density, you had better know what is on the disk.

Percom and other sources are now selling patch programs called Doublezaps which modify the NEWDOS-80 and VTOS 4.0 operating systems for double density compatability. Since I had been almost exclusively a NEWDOS-80 user, I was very much interested in this patch.

After observing it, I was somewhat disappointed. While orders of magnitude better than DBLDOS, the patched NEWDOS-80 is not compatible with single-density disks. It will read a single-density directory, which is an improvement, but any program to be run must first be transferred to a double-density disk. Some of the excellent copy routines of NEWDOS-80 were lost, when the original format routine was disabled and a double-density formatter substituted.

NEWDOS-80

Later, the opportunity arose to examine a NEWDOS-80 which had been patched with Doublezap II. A more expensive patch, this one includes a utility program called ADR/CMD for automatic density recognition. This allows you to have either single- or double-density disks in drives other than 0, which contains the double density system disk.

This appears to be a great improvement over the original Doublezap. The special NEWDOS-80 copy routines appear to be intact, and transferring files between single- and double-density disks is much simplified.

Making a backup, however, has to be done in two steps. First the disk must be formatted using a utility called DBLFMT/CMD. It is then copied using the NFMT option which, of course, is No Format. At some point in this operation, another utility, FIXBOOT/CMD must be run to apply the proper Boot sector to the backed-up disk.

While these patched programs do work, I am sure that NEWDOS-80 Version 2.0, which should be available by the time you read this, will be much better. Apparat is apparently doing a complete rewrite on the DOS and, as a bonus, Model I and Model III owners will be able to exchange files if both are using their respective versions of NEWDOS-80 2.0.

I have had no chance to observe the patch VTOS 4.0, so will reserve comment.

Both DBLDOS and the patched NEWDOS-80 will abort a format if five tracks are locked out. Since few of my disks are certified for double density, this happened several times.

In particular, the Doublezap II for NEWDOS-80 would not format anything in its original configuration. The format routine used puts a pattern of 6DB6's on the disk sectors. This is a worst-case pattern for double density. DBLFMT/CMD would not format any disk I had, including those rated for double density, until a zap was applied which changed the formatting pattern to the more common E5.

One of my greatest objections to LDOS was its extreme slowness.

After installing the Doubler II, I tried again with the 6DB6 pattern. It formatted and verified 40 tracks on everything but a very cheap, unbranded diskette. Even this could be formatted with 35 tracks.

Two of the later entries in the double density disk operating system field are LDOS and DOSPLUS.

LDOS

Some purchasers of LDOS were in for a surprise. Advertising for this close relative of VTOS 4 claims to support double density, and perhaps it does if one owns a Lobo expansion interface. (The DOS was originally marketed by Lobo Drives International of Goleta, CA. A separate organization, Logical Systems, has now been set up for this purpose.) Owners of the Radio Shack interface, however, found it necessary to obtain an additional driver program in order to activate the double density mode.

Activation is somewhat cumbersome, requiring that the system be booted in single density after which the driver may be loaded in one of two ways and, after this ritual is complete, one may switch a double-density diskette into Drive 0.

Once activated the system will read both single- and double-density diskettes automatically.

Perhaps it is not entirely fair to call LDOS a close relative of VTOS, since many improvements are said to have been made. With the skimpy VTOS documentation, who knew what capabilities that system had, anyway? Lobo has corrected this, issuing a manual of some 250 pages for LDOS.

One of my greatest objections to LDOS, whether single or double density, was its extreme slowness, a carryover from VTOS. If you called up a directory with the original version, it helped to have your lunch handy. A fix for this has now been implemented and LDOS has become a much better system.

Otherwise, LDOS appears to be a great operating system, containing many features usually found only on larger computers. Its owners swear by it.

creative computing
SOFTWARE PROFILE

Name: DOSPLUS 3.3D
Type: Disk Operating System
System: TRS-80 Model I or III
Format: Disk
Language: Machine Language
Summary: Impressive and useful
Price: $99.95
Manufacturer
Micro Systems Software, Inc.
Hollywood, FL

DOSPLUS

DOSPLUS seems to have been written with double density in mind from the beginning, and is the only operating system evaluated which gave me that impression. No patches or zaps to apply here, just stick the disk in the drive and go.

Priced at $99.95, DOSPLUS 3.3D is available from Micro Systems Software, Inc. of Hollywood, FL. A version is also available for the TRS-80 Model III.

DOSPLUS is compatible with all single-density operating systems for the TRS-80 Model I. What this means is that, as long as the double-density DOSPLUS disk is in drive 0, it doesn't care whether the other drives contain double- or single-density disks. DOSPLUS will read from or write to either one.

LDOS and DOSPLUS will also read one

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The 72 key keyboard includes an alpha lock key which simplifies operation with existing Apple software. The numeric pad cluster includes special keys such as period, plus, minus, greater than (go to) and asterisk (multiply) that are used frequently with VisiCalc.

The Franklin ACE 100 includes a joystick/ game paddle connector, a speaker and eight peripheral connectors. A built-in fan and a 50 watt power supply permit all eight peripheral connectors to be used without power or overheating problems.

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another's disks, but are not compatible with any other double-density system I have checked.

Some impressive utilities are resident on the DOSPLUS system disk. CLRFILE zeros a disk file without reallocating the file space. COPY1 is a file copying routine for single drive users. CRUNCH is a compression utility which removes unnecessary spaces and REMarks from Basic programs, the better to conserve memory.

CONVERT modifies TRS-80 Model III TRSDOS data disks to allow reading by the Model I. Since Model I and Model III DOSPLUS data disks are already compatible, no conversion is necessary.

DISKDUMP allows display and modification of a disk sector, accessed by disk file name. DISKZAP is similar in capabilities to the many zap programs on the market, but can be toggled to operate in either single or double density. Access by file name is not available in DISKZAP—the desired track and sector numbers must be specified.

The FORMAT utility allows formatting a disk with any number of tracks from 35 to 80 in either single or double density.

PURGE is just that, a means of rapidly deleting unwanted files from a disk. If you purge too many, RESTORE will recover them, or any other file which has been inadvertently killed, so long as it has not been written over. The exception, files which have been killed under TRSDOS are completely expunged from the directory and no recovery is possible.

RENUM is used for renumbering all or part of a Basic program.

SCRIPFIX is a patch which modifies your existing copy of Scripsit or SuperScript to operate under DOSPLUS.

SPOOL is a printer spooler that works. You can allocate a block of memory to the printer, and go ahead and do something else with the computer while it prints out what is in the reserved block.

TRANSFER copies all non-system files from one disk to another—very handy when you are moving files from single- to double-density diskettes. MAP prints out a listing of file allocations showing just where each one is located on the disk.

Library Commands

In addition to the usual Library commands, DOSPLUS contains a few which may be new to you.

BUILD creates a file composed of a chain of commands, which is then started executing by DO. By using DO in conjunction with AUTO, it is possible to perform a great many tasks in sequence simply by booting the disk.

CLEAR zeros memory above 5700H. CONFIG is used to set disk drive parameters, as well as telling the computer whether or not to send graphic characters to your printer.

CREATE allocates space on the disk for a file. Reserving this space in advance will usually cause your file to be recorded in one continuous block, rather than being scattered over the disk.

FORCE lets you set parameters for printer drivers. When you print out a LISTing with this system, it is very neatly divided into pages.

Typing FREE while running DOSPLUS does not produce the customary line telling how many granules are available on each drive. Instead, a disk map is printed out showing the status of each granule. "X" signifies that the granule is in use, a period indicates a free granule, "L" is a locked out granule, and "D" shows the directory granules.

The primary use of PAUSE is to stop execution of a DO file until the operator presses Enter, as when a disk must be changed. By means of the CMD function, it may also be used from Basic.

RS232 reads the switch settings on the RS232 serial port if one is installed, and allows changing them in software.

A global search and replace feature is included for ease of mass editing.

Extended Z-80 Disk Basic

DOSPLUS Extended Z-80 Disk Basic is compatible with Radio Shack Disk Basic, but minor syntax changes may have to be made if the following are used in a program statement:

PRINT &O for octal conversion is not supported.

CMD "S" will return an error message. To return to DOSPLUS, it is only necessary to type CMD and press Enter.

CMD "I" has been eliminated. To execute DOS commands from Basic, type CMD, enclose the desired command in quotes, and press Enter.

Unlike the Radio Shack system, no file buffers are reserved automatically upon entry into Basic. Both number of files and protected memory must be specified at the time Basic is called. For instance; Basic filespec-F:3-M:61000 will load Basic, open three file buffers, protect memory above 61000, and load and run the specified Basic program.

DI, when followed by two line numbers, as DI 10,100 will delete line 10 and insert it as line 100. DU is similar, except the first line is not deleted, it is duplicated at the new location.

Several new one- and two-character abbreviations have been added to make editing easier.

OPEN "E" opens a sequential disk file for output and places a pointer at the end of the file. Data may be added to the file without having to load it into memory first.

Variable length records are supported in the random file mode, up to a maximum of 256 bytes. Simply use the following format:

Open "R",1,"filespec",51

Your record length will be 51 bytes. If you specify a length that is not evenly divisible into 256, file space is not lost; records will span across sector and track boundaries.

The trace function in Basic, turned on and off by TRON and TROFF, is considerably different from what TRSDOS users are accustomed to seeing. The DOSPLUS version is actually a Basic single-stepper. Statements are executed one at a time by pressing either ENTER or the space bar.

CMD "REF",K,L,V prints out all references in your program to keywords, variables and line numbers. They may be referenced either all three at once, as above, or one or two at a time. Adding a "P" outputs the display to the line printer.

CMD "M" displays all variables currently allocated, along with their values.

Would you like chaining capability between Basic programs? Adding a comma and "V" will save the variables from your current program, and carry them over to the program "TEST/BAS." Variables set as a literal or through DATA statements are not saved.

A global search and replace feature is included for ease of mass editing. Activated by CMD "SR", it will search the entire Basic program and display or replace any string variable or expression. From an example given in the DOSPLUS manual, CMD"SR",":",CHR$(10)+":" will search the whole text and insert a line feed in front of every colon, thus making the program easier to read.

As if all that were not enough to make a great system, Micro Systems Software has also included TBasic on the DOSPLUS disk. This is a tiny Disk Basic which will give users approximately 3K of extra memory space.

While DOSPLUS documentation is not extensive (it consists of a 48-page manual), it is written in an easy to understand style and appears adequate.

If you have the impression by now that I think double density is great, you are absolutely right.

Transferring most of my files to double density allowed recovery of more than three boxes of disks. Now, if the amount of software doesn't expand too fast... □

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The 8K Extended BASIC chip used in the ZX81 is available as a plug-in replacement for your ZX80 for only $39.95, plus shipping and handling—complete with new keyboard overlay and the ZX81 manual.

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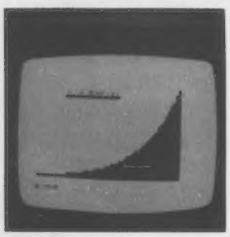

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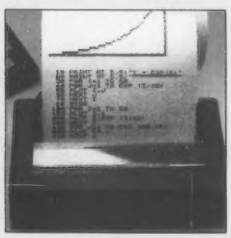

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The TRS-80 Model II and Pickles & Trout CP/M

Andrew Klossner

Early in 1981, I needed a system on which to run CP/M version 2. My requirements included a fast Z80, a full complement of memory, large memory-mapped video display for word processing, a detachable keyboard with a good feel and upper and lower case, and an 8" floppy disk drive.

As a hardware novice, I needed service facilities. As a regular working bloke, I needed something inexpensive. My choice: a Radio Shack TRS-80 Model II, for which I paid $3400. After six months of daily system use, I have yet to regret it.

The Hardware

The design of the Model II is far better than the Radio Shack reputation led me to anticipate. It represents an excellent trade-off between cost and features. It is also one of the first desktop computers to pay serious attention to human engineering and ergonomics.

In one package, the Model II incorporates an 80 x 24 character display and an 8" double density floppy disk drive. Inside there is a Z80 microprocessor ticking at 4 MHz, 64K of usable RAM, a Centronics printer parallel port, two RS-232 serial ports, and two real time clocks. The keyboard connects via cable. Since you pay for a single cabinet and power supply, you save a great deal over the cost of separate components, although you lose the ability to upgrade your system selectively.

External Organization

The keyboard features upper and lower case in the standard QWERTY layout. Special keys include Tab, Esc, Backspace, Break, Hold, Enter, F1, F2, and four cursor control keys. A numeric keypad lies to the right. The tilde, backslash, vertical bar, and rubout characters are typed by holding down the Ctrl key and striking "6," "9," "0," or "-." There is no way to type an accent grave; this annoying deficiency means that 127 of the 128 possible ASCII codes can be entered.

There are no "typeamatic" keys. Instead, a Repeat key is provided. Both a Lock and a Caps key are included; the former works like a typewriter Shift Lock, while the latter locks only the letters to produce all upper case. Both keys glow red when active, thanks to embedded LEDs.

The display uses a white phosphor. Warmup of the tube takes less than four seconds; it comes on before CP/M finishes booting. The character set is well designed and is pleasing to look at, with true lower case descenders. Besides blank and the standard 94 printable characters (including accent grave), there are 33 "business graphics" characters, useful mostly for margins and bar charts. Each character can be displayed in normal or reverse video.

The disk drive is mounted to the right of the display, facing the operator. My unit came with a Shugart 801 which seeks reliability at six milliseconds per track. This means that there is no meat grinder sound; head movement is whisper quiet. A disk expansion unit with up to three additional drives can be connected at the back.

The Power and Reset switches are located between the display and the disk drive. This position of the Reset key is far superior to a place on the keyboard (where it can be accidentally struck, to disastrous results) or on the back of the chassis (where you have to fumble to find it). To reset the computer, you must lift the key, so a falling object will not affect it. This is, unfortunately, not true of the Power switch, which is On when raised and Off when lowered. Power status is indicated by a red light between the two switches.

The Centronics and RS-232 connections are at the back of the chassis. After removing two screws and breaking the

Andrew Klossner, P.O. Box 283, Wilsonville, OR 97070.

warranty seal, the cover can be pushed back and swung up and away. This is harder than it sounds; in learning the trick, which is described nowhere in the available documentation, I broke two of the four plastic pins which hold the cover flush with the back chassis wall.

Internal Organization

The system is based around a custom bus, which is designed to make full use of the Z80 family of parts. All peripheral interfaces are interrupt driven, and the disk controller is capable of performing direct memory access, so that disk I/O and computation can be overlapped. Boards are plugged into an eight-slot backplane, of which only four are used in an off-the-shelf unit.

The power supply is not extravagant; when the disk head is loaded, the display image contracts. A ventilation fan spins constantly when power is on.

The CPU board contains a Z80A, along with a DMA chip, two SIO ports, a counter/timer chip, and a 2716 ROM. The ROM is mapped into the lower 2K of memory upon power up or Reset. The bootstrap code performs extensive diagnostics, then loads the operating system from disk, which disables the ROM with an OUT instruction to leave RAM throughout the memory space.

The floppy disk controller board features a Western Digital 1791 controller chip which can manipulate single or double density disks. Although Radio Shack doesn't advertise it, the board contains all the necessary circuitry to run a double sided drive. It also has a PIO chip for the Centronics port.

The video/keyboard interface board holds an additional 2K of RAM, which can be mapped into the top 2K of memory at the flip of a bit in an I/O port. Each of the first 1920 bytes corresponds to a character position on the screen. A reverse video (black on white) character is selected by setting the high bit. A Motorola MC6845 chip drives the display and supports various sizes and speeds of blinking cursors.

This board also has a 60 Hz clock and the keyboard interface, both of which signal interrupts by pulling on the NMI (non-maskable interrupt) line.

The fourth board contains either 32K or 64K of dynamic RAM, depending upon which option you order. Bank select circuitry is provided, allowing any of up to fifteen 32K pages to occupy the upper half of active memory. Further memory boards can be purchased to expand the system to as much as 512K, but neither TRSDOS nor CP/M supports more than 64K RAM.

The Software

The Model II comes with TRSDOS and a Microsoft Basic interpreter at no extra charge. However, since I bought my computer to run CP/M, I rarely boot the Radio Shack disk.

After researching the available implementations of the CP/M operating system for the Model II, I bought CP/M version 2.2 from Pickles & Trout. The BIOS (Basic I/O System, the code which must be customized to each new machine) in this package is well thought out. It includes several practical features, while eschewing the expensive flash incorporated into CP/M by many hardware manufacturers. Contrary to published reports in some usually reliable periodicals, no hardware modification is necessary to support CP/M on the Model II, and there is no point in asking a Radio Shack dealer to install the CP/M "option."

Perhaps the most useful aspect of this software is its support of virtual disk drives. This allows a program on a single-drive machine to run as though up to four drives were on-line. When the program attempts to switch to a new drive, CP/M displays a message asking the operator to mount the appropriate disk, then waits for Enter to be typed.

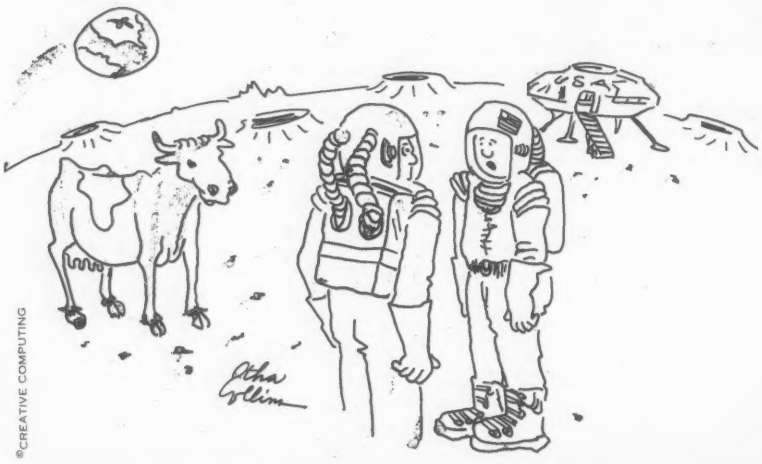
Another extremely important feature is a software type-ahead buffer, which allows keystrokes to accumulate until called for. Many word processing packages also incorporate this feature at the application level, but, unless it is present in the operating system, keystrokes entered during disk I/O activity can be lost.

P&T CP/M supports both the standard single density disk format and its own double density format which provides 600K bytes per volume. This latter is implemented with 512-byte physical sectors, and is a great improvement over the 480K available on a formatted TRSDOS diskette. Only a double density disk can be made bootable.

The operating system allows the baud rate of the serial ports to be selected independently. Any of three different handshaking techniques can be specified, to allow slow devices to request a pause in the flow of data while they catch up. I connect a NEC Spinwriter and let CP/M perform XON/XOFF handshaking; the printer sends control-S to stop output, and control-Q to resume.

The console output routine in the BIOS emulates a CRT terminal by accepting characters and placing them into video memory. Control characters such as carriage return, line feed, backspace, and tab cause the standard display result. Other control codes are defined to perform functions such as clear screen, line insert/delete, toggle reverse video mode, toggle graphics mode, and direct cursor addressing. A program can also request that the video RAM be mapped in for access, allowing near-instantaneous screen update by word processors.

Besides the standard assembly language program entry to the BIOS through location 0, P&T CP/M supports an alternate entry point at location 40 through which additional services can be requested. These include configuring the I/O ports, performing serial or parallel I/O, setting and reading the time of day clock, and selecting display options such as whether lines wraparound or the cursor blinks.



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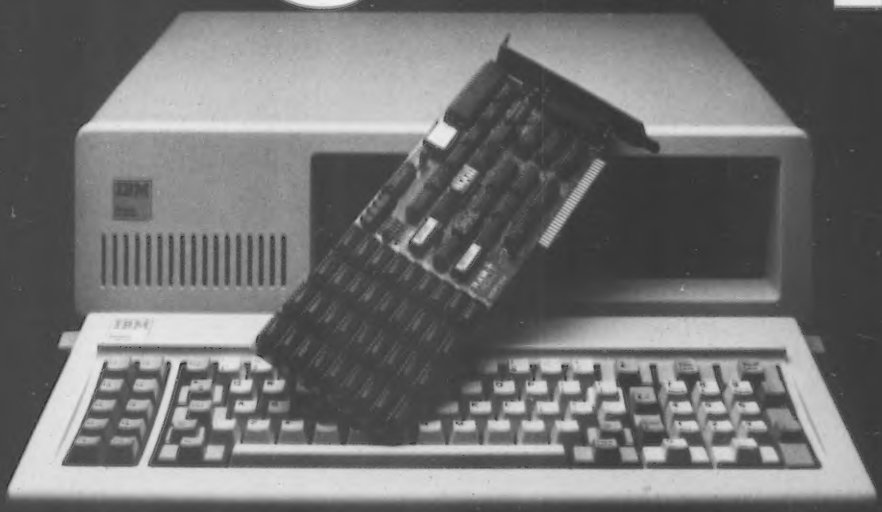

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In addition to the usual utilities, P&T CP/M comes with programs to format and certify diskettes, configure I/O ports, and select disk seek rate. The IOFREEZE program allows the operator to set default attributes, which apply when the system is booted. AUTOEXEC can be used to select a command for execution upon every cold or warm boot. TRS2CPM reads a file from a TRSDOS disk. FASTCOPY copies one disk to another, and is optimized to function well with a single disk machine, where it fills all of RAM with data before asking the operator to switch disks.

The major drawback to Pickles & Trout CP/M is that the source code for the custom BIOS is not included. Even a listing would be valuable to the assembly language programmer trying to make full use of the hardware. For example, a program can request that a specific routine be given control when the counter/timer ticks, which happens 100 times per second. This routine must return via the RET instruction. There is no way to determine the contents of the user's registers at the time of the interrupt, or to modify the PC before returning, as a debugging routine might need to do.

Another problem, which may be either a hardware or software fault, is that activation of the Reset key when the disk is active does not completely reset the computer. Typically the display screen fills with garbage, the disk remains active, and subsequent use of Reset is ineffective. In these cases, the only way to recover is to power down the machine for fifteen seconds. This is especially inconvenient when a lengthy, disk I/O bound program must be halted.

For those who are handy at connecting different disk drives, P&T offer versions of CP/M which support double sided drives, for a capacity of 1.2 megabytes per volume, and versions which work with Winchester hard disk units.

Pickles & Trout CP/M represents one of the best jobs of customization in the CP/M domain.

The Documentation

The TRS-80 Model II comes with an owner's manual, which contains brief operating instructions, a TRSDOS manual, and a Basic manual. For thirty dollars you can get a technical reference manual, which is extremely complete and well written. It includes fully annotated schematics for every circuit and a separate chapter for each board and major component, as well as the manufacturers' data sheet for the LSI chips. It could be improved only by the addition of a listing of the boot ROM.

Pickles & Trout CP/M comes with the usual five manuals from Digital Research. In addition, a well written user's manual introduces the reader to CP/M and details the additional features provided by the custom BIOS.

A Personal History

When I first decided to buy a Model II, I approached the local Radio Shack Computer Center about the possibility of leasing, which they were pushing in a newspaper advertising campaign. It turns out that the lease program is intended only for businesses, not for consumers; my application was turned down.

I then did some shopping around to see what range of prices was available. All the stores that I visited which carried the Model II charged the list price of $3890. The hobbyist magazines, on the other hand, were full of ads from mail order houses with prices as low as $3400. I selected a dealer who is located within a comfortable drive of the factory in Texas and sent him my life's savings; shortly later, my new computer appeared at the local airport.

The system worked flawlessly for a month, but then began to show some flaky behavior patterns. These were characterized by a failure of the self test upon power-up or Reset.

In addition, the disk drive head began squeaking at the six milliseconds step rate,

GLOSSARY

Non-maskable interrupt—An interrupt is a signal that stops the normal program flow and causes execution of a specific vectored routine, after which control returns to the original program. Some interrupts can be disabled by setting a bit mask. A non-maskable interrupt cannot be stopped.

Controller chip—Any processor dedicated to control of a peripheral such as a disk drive.

Handshaking—Communication between a computer and peripheral or other computer, indicating whether a device is ready to send or receive data.

Wraparound—The continuation of a word from the right margin of a screen to the left margin of the next line.

Format (verb)—To place output in a predetermined form or arrangement. Also, to prepare a disk for data storage.

Source code—A program in human-readable form before compilation or assembly. Source code usually includes comments and meaningful labels.

Assembly language—A mnemonic representation of machine language. Assembly language uses op codes such as JMP (for jump) rather than the actual hex value that represents the instruction.

Register—A location in a microprocessor that is capable of holding a value. Used to load and store memory, and for internal operations.

Port—A hardware location used for input or output of information.

ASCII codes—The American Standard Code for Information Interchange, which represents alphanumeric characters and special controls as numbers.

White phosphor—The coating on the inside of a television picture tube which produces a white dot when exposed to an electron beam.

Bus—The lines connecting processors, memory, and other portions of the computer that send or receive data.

Z80/Z80A—One of the more popular microprocessor families, containing a powerful instruction set.

Interrupt driven—A device or routine that operates during interrupts.

CPU—Central processing unit. This is the microprocessor on which the computer is based.

DMA Chip—A chip which can read memory using Direct Memory Access rather than requiring information to be passed by the CPU.

Bootstrap—A routine that allows the computer to read other programs. In essence, the computer is pulling itself up by its bootstraps.

PIO chip—A chip dedicated to Programmable Input and Output.

Bank Select Circuitry—A system allowing a CPU to address more memory than it is designed for by switching between different banks of RAM.

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and I had to increase it to ten and put up with the meat grinder sound.

Eventually the machine failed so completely that the power-up sequence ended with a display of garbage, and I had an opportunity to investigate Radio Shack's claim of readily available service. I took the machine to the local Computer Center for maintenance under the terms of the ninety day warranty.

This first experience with the service department was extremely frustrating. To begin, they promised to have my computer ready in 24 hours, or "48 at the outside." A week came and went while it sat unattended in the back of the repair depot despite daily telephone calls. In accordance with Murphy's Law, when they finally began to run their diagnostic package, it worked flawlessly, so they didn't bother to open the box. Eventually I retrieved it and spent the rest of the warranty period making regular impact adjustments with my shoe.

On the day that the warranty expired, a hardware-wise friend popped the cover and immediately spotted the problem. The bar which holds the boards against the backplane had too much give, and the boards were working their way out. Also, many of the socketed chips were not well seated. A bit of re-seating eliminated the flakies, and a spot of lubricating oil on the disk drive ended the squeaks. (The lubrication procedure is described in the P&T manual.) If the service technician had been at all experienced with the Model II, he would have recognized my symptoms and done this himself.

I selected a dealer and sent him my life's savings.

Several months later I had cause to return to the service department when the machine failed again. I was prepared for another nightmare, but this time I came away satisfied. There had been a complete turnover of service personnel, and the new technician diagnosed a bad disk interface board, swapped it for a good one, and made a variety of mechanical adjustments in less than two hours while I read science fiction in the front office. He also ran the P&T disk certification utility to check out the new board; TRSDOS has no analogous program. Although the computer was out of warranty and my bill was over $100 (of which $70 was for the board switch), I was happy with the experience and will not hesitate to return if another problem develops.

In all honesty, I must shoulder some of the blame for my computer's failure. For several months I used it both at home and at work, and it commuted with me. The resulting jostling was doubtless the cause of the loosened boards. The Model II is not advertised to be portable, and I have no doubt that if I had installed it in one spot and never moved it, it would not have failed.

Conclusions

The TRS-80 Model II is an excellent CP/M system for the person who is not well versed in hardware. To date, it is alone among inexpensive all-in-one units in offering a standard 8" disk drive instead of 5¼" minifloppies.

When purchasing a Model II, the buyer should ensure that the seller is an authorized Radio Shack dealer, and should get the dealer's "authorized dealer number" for presentation when obtaining service under warranty. If a Model II is bought from an unauthorized dealer, the warranty is voided.

Pickles & Trout CP/M represents one of the best jobs of customization in the CP/M domain. The resulting programming environment is head and shoulders above the more mundane efforts produced by many hardware manufacturers in support of their systems.

CP/M version 2.2 is available for $175 from Pickles & Trout, P.O. Box 1206, Goleta, CA 93017. □

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A Hard Disk's Night

An In-Depth Look At Mass Storage Options

Glenn A. Hart

Someone once said that you could always identify the pioneers in the Old West—they were the ones with the arrows in their behinds. I've always disagreed with the implied philosophy that you are always better off waiting a while before trying new things.

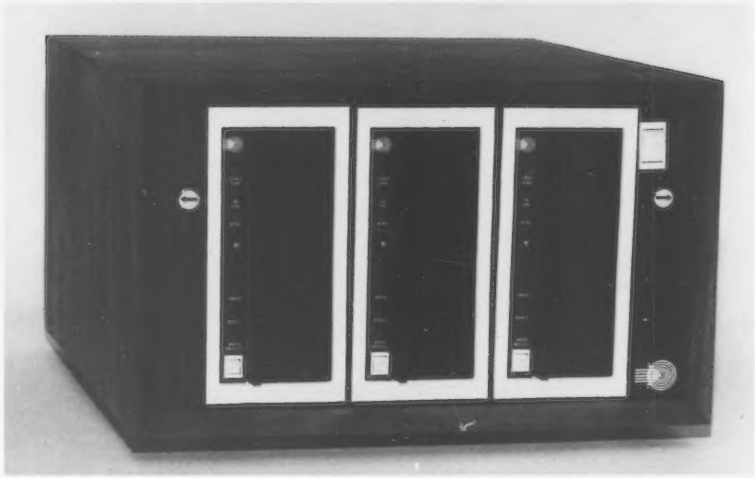
There are those who say that a new technology will be further perfected, a given format or design might become obsolete, the price will come down and many other rationalizations for procrastination. I feel that while all these things might happen, I can be deriving much pleasure from the new device and have a head start on understanding whatever the new technology brings.

Of course, I pay a price for this; sometimes the price *does* come down and equivalent or superior devices are available for far less than I paid for my early version. All in all, however, pioneering pays great dividends.

Most of my friends and associates in the microcomputer field very much subscribe to this point of view. We were real pioneers in the distant past (only five years ago) when microcomputers emerged as an almost science-fiction-like new frontier. We all knew that micros were something special, devices that would someday change the face of our society, and we all wanted a piece of the action.

All of us spent (and continue to spend) uncountable hundreds and thousands of hours tinkering, experimenting, working and playing, and all of us came away richer in some way from the investment of capital and time; some have earned significant amounts of money, some have made microcomputers their life's work, all have expanded their horizons and learned more about both the equipment and themselves.

Glenn A. Hart, 51 Church Road, Monsey, NY 10952.



If you gather that I enjoy computing, I've made my point! I was in the game early and have never regretted it. Over the years, I have had four major computer systems (as well as several secondary systems, programmable calculators, pocket computers, etc.)

During this period, remarkable changes have taken place in many areas. A 16K system was pretty big at the beginning, now I have 256K. We were excited by the features offered by 8K Basic interpreters, now I have well over a dozen high level languages, some of which occupy tens of thousands of bytes through sophisticated overlay techniques.

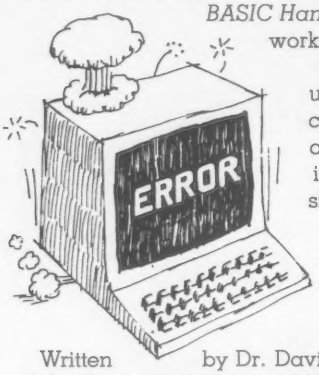
My video terminal operates at 19,200 baud, a bit faster than my first 300 baud terminal. My slow and noisy 40-column printer has been replaced by a combination of daisywheel and 300 line per minute high speed printers. Word processing, financial planning, and other powerful programs are a far cry from our early delight in checkbook balancing programs.

For all of this, perhaps the greatest hardware changes have taken place in the mass storage devices available for microcomputers. Mass storage affects two main areas of system operation: the amount of data which can be stored "on-line," or readily accessible, and the speed and convenience of overall system operation. Both factors are extremely significant in determining the appropriate uses of a given system, and the limitations imposed by mass storage usually have a greater impact on what a micro can do than which CPU is used, the system clock speed, the type of terminal and its speed, what kind of printer is used, etc.

Each of the four systems I have had has used increasingly sophisticated mass storage devices. An examination of each system will show how far microcomputers have come in a relatively short time and allow us to review the main types of mass storage peripherals currently available.

When your computer won't speak your language, you need a basic handbook.

As a matter of fact, everyone who works in BASIC needs *The BASIC Handbook*. It is *the* definitive reference work on the subject of BASIC.



The BASIC Handbook is an easy-to-use encyclopedia of nearly 500 words covering the "dialects" used by virtually every BASIC-speaking computer in the world. But more than that, it's a simple, step-by-step guide to translating programs from one computer to another. So now you can actually *use* software printed in magazines and elsewhere, no matter what computer you own.

Written by Dr. David A. Lien, author of the *Tandy TRS-80 Level I User's Manual* and the *Learner's Manuals* for the Epson MX printers, this completely revised Second Edition contains almost twice as many entries as the best selling First Edition, making it by far the most up-to-date BASIC reference book you can buy.

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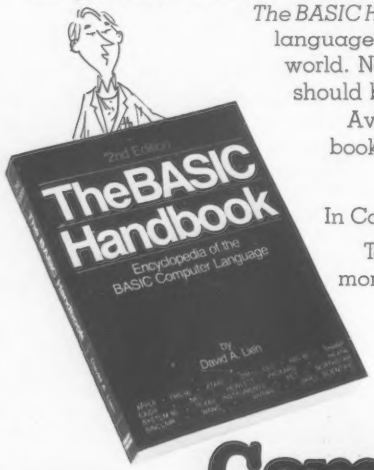

The BASIC Handbook is available in several languages and accepted throughout the world. No one who programs in BASIC should be without it.

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Hard Disk, continued...

The Early Days: Audio Cassettes

My first system was a Southwest Technical Products 6800. I built it completely from kits. While I had assembled many tube kits, including various stereo equipment, oscilloscopes and even a color television, this was my first experience in building anything using IC's. I found the process painstaking and a bit frustrating, but, as with all kit building, the sense of satisfaction when the thing worked was immense. The SWTP mainframe contained a Motorola 6800 microprocessor running at 1 MHz, Motorola's excellent MIKBUG ROM monitor, serial output and a staggering 8K of RAM.

Mass storage was provided by the SWTP AC-30 audio cassette interface and two Panasonic portable cassette recorders. During these pioneering days there were several incompatible cassette storage formats and speeds. Eventually a "standard" emerged. Known as the Kansas City format, it used the crawlingly slow speed of 300 baud (about 30 characters a second) to ease the demands on early interfacing technology and improve the shaky reliability and reproducibility of audio cassette transfers.

Loading the SWTP 4K Basic interpreter required several minutes.

The AC-30 used this standard, which resulted in *very* slow loading and saving to the audio cassettes. Loading the SWTP 4K Basic interpreter required several minutes, and after I had expanded to the then heady realm of 16K RAM and an 8K interpreter I frequently turned on the system, began the loading process and then left to have a sandwich.

Loading the few application programs (usually games) then available was an equally laborious process. Reliability was reasonably good, although an error in saving or loading was especially aggravating given the length of time required to try again. At least the long time intervals gave me a chance to soak up all the magazine articles in the new personal computing magazines!

Audio cassettes can store a large amount of data, since their storage capacity is limited only by the length of the cassette tape itself and the density of the data per linear distance. Unfortunately, tape storage is basically sequential nature, meaning that each bit of data must be read on the way to the desired information.

While various schemes have been devised to get to the target data more quickly, and

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data transfer rates have been increased with the availability of improved interfaces, better recorders and greatly improved tape formulations, audio cassettes are still an intrinsically slow storage method. Combined with the general lack of random access, no serious business applications are feasible with a cassette-based system. Audio cassettes are extremely inexpensive, though, and do offer a viable entry level storage method for the beginner.

Mini-Floppies Arrive

My patience with cassettes wore thin almost immediately, as it seems to with almost everyone I know. At that time there wasn't much software available for the 6800 compared to the 8080 family, the S-100 bus was becoming dominant and a new storage medium was fast gaining popularity—the 5 1/4" mini-floppy disk.

This was enough for me, and I bought a system from Computer Data Services in Maryland. It was an integrated desktop unit which used the new 8085 processor and housed a keyboard, video monitor, 32K of high speed static RAM, S-100 motherboard and one single-density mini-floppy drive in a neat cabinet. The floppy drive was made by the then infant Micropolis, but the system used the popular North Star controller and the North Star Basic and DOS disk operating system.

My patience with cassettes wore thin almost immediately.

North Star was really the first floppy disk system to gain wide popularity. It was (and is) reliable and affordable, and the free Basic interpreter and DOS were absolutely state-of-the-art at the time. What a difference it made. Now the 12K Basic and applications programs could be loaded in a few seconds rather than long and boring minutes. The Basic was powerful and flexible, allowing full random access.

One of my first activities was to translate a complete inventory system I had written for a time-sharing Basic, and my micro was now handling a multi-million dollar product inventory.

The mini-floppy itself is a 5 1/4" square envelope of cardboard which surrounds a circular piece of polyester coated with magnetic material. A low friction material coats the inside of the cardboard so the magnetic disk can rotate freely. The magnetic substance is an iron oxide suspended in special binders and lubricants.

Various holes are punched into the sleeve and the disk itself. The large center hole is grasped by a spindle in the drive, very much like a jukebox in its operation, while another opening allows the read/write tape head in the drive to contact the disk. Yet another hole indicates to suitably equipped drives whether the disk can be written to or is "write-protected."

There are two main methods of keeping track of which part of the disk is being read or written to. In hard sectoring, a series of either 10 or 16 holes is punched around the large center hole, while soft sectoring requires only one of these index holes. A photoelectric device in the drive senses the position of the indexing holes.

If soft sectoring is used, the one available index hole is not sufficient to provide all the positioning information necessary, so data written on the disk itself accompanies the information stored to provide location clues to the electronics which control the drive. Hard sectoring doesn't require this added overhead, but either method works fine.

The tape head actually comes into full contact with the disk surface, just as it does in an audio cassette or open reel recorder. Because of this, the disk can spin at only a few hundred RPM. Furthermore, the iron oxide coating is quite abrasive, so friction eventually wears both the tape head and the disk surface.

Several variations on the original single-sided single density mini-floppy are available, each attempting to cram more data onto the little disk. If the distance between concentric data tracks is reduced, more tracks can be accommodated. The original mini-floppies used 35 tracks, but now drives with up to 96 tracks can be found. Increasing the number of tracks requires much more precise design and construction.

Another method of increasing storage is to use both sides of the disk. A cheap and easy method of storing more data on each single disk is to carefully punch an index hole on both the top and bottom of the sleeve so when the disk is turned over the index hole will be in the right place. Commericial disks which are manufactured with the two holes already punched are also available. These "flippies" don't make any more information available "on-line" (readily accessible); they just put more data on a disk.

To get more data storage *on-line*, special drives are available which use *two* read/write heads to access each disk. These double-sided drives double the amount of information available. They are more expensive than normal single-sided drives, are a bit harder on the disks themselves, and at least when first designed were somewhat less reliable than standard drives, but recently the bugs seem to have been worked out. My North Star-type system didn't store enough for really large-scale programs, but the newer double-sided high-track mini-floppies can be used for many serious applications.

A Step Up

My single drive mini-disk system just couldn't keep up with my storage needs. I could have added an additional external drive, but I was becoming annoyed by the limited storage capacity of the mini-floppies and wanted to add microcomputing to the division of the major corporation I then ran.

Getting a system for my division was quite a story in itself. The mainframe computer department didn't know much about micros and viewed them as something of a threat to their control of data processing (it is a sad commentary that this attitude *still* prevails at many companies, although the situation is rapidly changing), so we sneaked the system in on a general office equipment budget.

Once it was in place, we unveiled it for our senior management and showed them all the custom programming I had done and the tremendous time savings we were achieving. Fortunately, they were pleased enough to not dismiss me and my immediate superior.

The extra storage provided by 8" drives was wonderful.

I purchased two Imsai VDP-80 computers, one for the company and one for myself. The VDP-80 used an 8085 processor, the excellent VIO memory-mapped video, an intelligent keyboard, a seven slot S-100 bus cardcage and 64K of dynamic RAM with a ROM monitor as well. Mass storage was provided by a Persci 277 dual 8" floppy drive. Double density was available, albeit in peculiar Imsai format which no one else used before or since. All this was housed in an attractive single enclosure, an important consideration for business use.

Persci drives are significantly faster than other 8" drives because they use a voice-coil positioner for head movement. Most drives use a stepper motor (a special motor which moves in discrete distance or revolution increments) connected to the head by either a turn screw or band actuator. The voice-coil mechanism is much like the voice coil found in a speaker; it can move to any positon based on a voltage.

The extra storage provided by 8" drives was wonderful. In single density mode each drive held about 240K of data and double density more or less doubled this, giving us about a million characters of storage on-line. This allowed storage of large program systems and lots of data as well.

The Persci drives themselves were a distinctly mixed blessing. The ones I had in my home system never gave me a bit of

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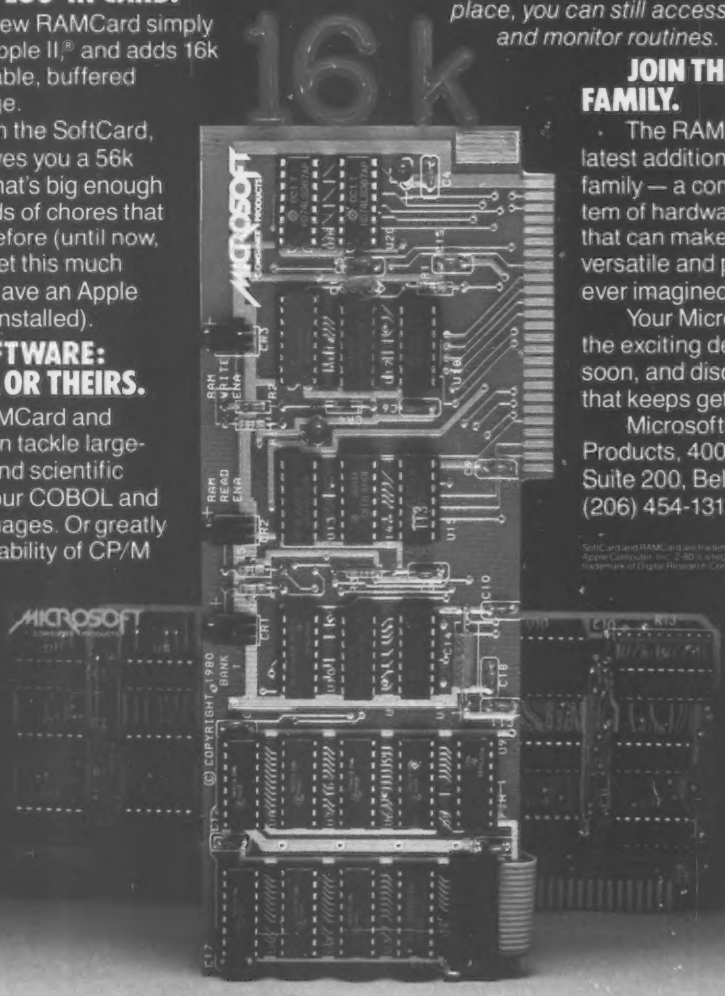

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Having just purchased an ATARI 800 Home Computer, it occured to Herrera that this could be the perfect tool for testing Steve's vision. So he wrote a program simply displaying the letter "E" in various sizes.

Success! It turned out that 2-year-old Steve could see even the smaller "E's" without special lenses. Herrera was first relieved, and then intrigued when he discovered that not only could his son see the "E's," but he would happily play with the computer-generated letters for hours. So Herrera added a picture of an elephant to go with the "E," and then more letters and pictures. Thus, "My First Alphabet" was born, a unique teaching program for children two-years and older consisting of 36 high resolution pictures of letters and numbers.

Herrera submitted the program to the ATARI Program Exchange, where it became an instant best-seller. ATARI was so impressed with the outstanding design, suitability and graphic appeal of "My First Alphabet," that the program is being incorporated into the ATARI line of software.

In addition to his grand prize winnings of $25,000 in cash and an ATARI STAR trophy, Herrera also automatically receives royalties from sales of his program through the ATARI Program Exchange.

But Fernando Herrera wasn't the only software "star" that ATARI discovered. Three other ATARI STARS were awarded at the ASAP awards ceremony for software submitted to the ATARI Program Exchange and

judged by ATARI to be particularly unique and outstanding.

Ron and Lynn Marcuse of Freehold, New Jersey, teamed up to write three winning entries in the Business and Professional category for home computers: "Data Management System," "The Diskette Librarian" and "The Weekly Planner."

Sheldon Leeman of Oak Park, Michigan, captured an ATARI STAR for his exceptionally well-engineered "INSTEDIT" character set editor.

Greg Christensen of Anaheim, California, became our youngest ATARI STAR winner at the age of 17. Christensen designed the clever "Caverns of Mars" game program, which also will be incorporated into the ATARI product line. Greg designed the program in 1½ months after owning his ATARI Home Computer for less than a year.

Every three months, ATARI awards ATARI STARS to the writers of software programs submitted to the ATARI Software Acquisition Program and judged first, second and third place in the following categories: Consumer (including entertainment, personal interest and development); Education; Business and Professional programs for the home (personal finance and record keeping); and System Software.

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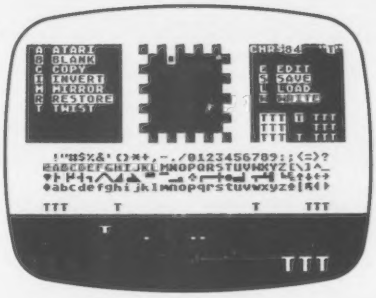

After submittal, consultation from ATARI is available if you need personal assistance with sound, graphics, or other technical aspects of your program.

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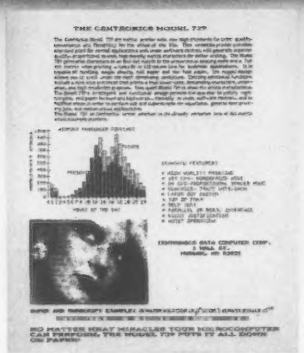

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trouble and worked flawlessly from the first day I got the system until I recently sold it (I am told they continue to operate perfectly for the new owner).

The CBS machine was a different story. We exchanged the drives several times, serviced and adjusted them frequently, and were never completely satisfied. With only these two machines to compare, I can't tell whether I just was lucky or the much heavier demands placed on the system in a business environment were too much for either the drives or the Imsai unit itself. Cramming all that componentry into one cabinet made the VDP-80 run rather warm, and I suspect this may have been part of the problem.

The same technologies being applied to mini-floppies are also being used to expand the storage capacity of 8" drives. Double-sided drives are becoming much more common, and the early reliability and media wear problems have been largely ironed out. A double-sided drive in double density mode can store upwards of a million characters, so these drives have great appeal to business users.

There hasn't been as much effort expended on increasing the track density of 8" units, but Persci recently announced 8" drives which can store as much as eight megabytes of data on a normal floppy disk. I haven't seen any such units myself, but they obviously would be appealing if they work as claimed and are reliable.

The State-of-the Art

I quickly found the limited card slots available in the VDP-80 very restricting, since I wanted to experiment with voice recognition, speech synthesis, power control, computer music and many other hobby applications. My newest system has enough capacity for this and much more.

An Imsai mainframe (chosen for the operator switches and LED indicators) was modified with the excellent Godbout 20-slot high speed actively terminated motherboard. Industrial Micro Systems (now IMS International) S-100 boards form the nucleus of the system and provide a Z-80 operating at 4 MHz, 256K of high speed RAM with parity detect (a method of detecting certain kinds of memory errors), six serial and three parallel I/O ports and a DMA 8" double density floppy disk controller. Many other S-100 boards happily share the mainframe, including Computalker speech synthesis, Heuristics speech recognition, Scitronics AC power controller, PMMI modem, Newtech music synthesizer, Digital Research of Texas sound effects generator, Strobe plotter parallel interface, Computime time-of-day clock, etc. Peripherals include an IMS WP-2000 video terminal, a Diablo 1650 KSR metal daisy wheel printer, a Teletype 300 line per minute high quality line printer, the Strobe drum plotter reviewed in the September issue of *Creative*, Anderson-Jacobson 1200 baud modem, etc.

The 8" floppy drives are from a little known company named Innotronics. Their 8" drives are absolutely marvelous devices which are essentially hand made and use many components which are far superior to those found in normal commercial drives.

For example, the drive spindle is constructed completely of precisely machined and hand polished stainless steel rather than the cheaper aluminum castings normally employed. The disk clamping mechanism uses proprietary material which is much gentler to the disk center hole than the gripping teeth on standard drives.

A filtered air positive pressure system directs heat away from the motor and electronics and keeps dust and other damaging particles away from the magnetic surface. Special circuits write-protect the data if power deteriorates, while other circuits control automatic head unload and stepper power timeouts to reduce media wear and power consumption.

The magnitude of the difference between floppy and hard disk based systems is as great as that between cassette and floppy.

Each drive has six status LEDs which indicate whether the drive has a disk loaded or is ready to accept a disk, when a drive is being accessed, whether reading or writing is being done and whether the drive is write-protected, either by a write-protected disk or with the write-protect switch included on each drive. My three drives are housed in an Innotronics enclosure which is built like a battleship, including a very large power supply and over-rated power switches which control the AC power to my entire system.

The drives are totally reliable, quiet and solid. The truly remarkable thing about them is that they don't cost all that much more than normal drives. For example, Innotronics markets a three-drive system which is totally compatible with the three-drive system Radio Shack sells for their TRS-80 Model II business computer and the price is exactly the same.

Why anyone wouldn't want the Innotronics is beyond me, but the company is small, selling most of their production to medical instrumentation companies and other industrial users who readily appreciate their incredibly high quality, so little if any advertising money is available and the company just isn't very well known. Everyone who sees my drives wants them, and I strongly urge anyone who wants the best to contact the company directly.

Hard Disk

That brings us to the latest development in mass storage, the hard disk. The hard disk offers tremendous advantages in two main areas: huge storage capacity and extremely high speed. Both of these factors make a major difference in system operation; I think it is fair to say that the magnitude of the difference between floppy and hard disk based systems is as great as that between cassette and floppy.

Many of the concepts used in floppy drives are also employed in hard disk units, only more so. The performance advantages of hard disks derive from a combination of several factors.

The major distinction between hard and floppy disk systems is that the tape head in a hard drive does *not* contact the magnetic surface. Rather than coating the oxide on a flexible substrate, a rigid aluminum disk is used. The combination of the oxide and the hard disk is extremely uniform and can rotate at much higher speeds without deviation in any direction. Most hard disk drives rotate the disk at 3600 RPM, a full order of magnitude faster than floppies. As in audio turntables, either belt drive or direct drive can be used.

The rapid rotation of the disk creates a thin layer of air immediately above the disk surface, similar to the "ground effect" noted by airplane pilots. The read/write head takes advantage of this phenomenon; it is designed to "fly" a very small distance above the actual magnetic surface, usually about 1.5 microns.

Various head designs are used, but most have actual "wings" to insure that the distance between head and magnetic coating is maintained. At the high rotation speeds used, it is imperative that the head not touch the surface to avoid gouging out a destructive track (the infamous "head crash"). There is a designated safe area for the head to land when power is removed. The narrow gap physically separates the head and the oxide but is more than close enough for the magnetic gap to read or write to the oxide surface.

It is difficult to envision how small the 1.5 micron gap really is. Almost *anything* is bigger than this. A fingerprint, human hair, dust particle or even a particle of smoke is *much* larger and would instantly clog the gap and gouge the oxide surface, resulting in loss of data. The answer is to seal the drive in a chamber into which no such contaminants can enter. IBM pioneered this method several years ago. Their prototype was designated the Model 3030 and was accordingly nicknamed the "Winchester."

The integrity of the head/surface interface, even with very high speed rotation, allows for very dense track spacing and resultant high storage capacity. Most hard

disk drives use multiple hard platters with read/write heads for both sides of most of the platters, further increasing capacity. The speed of data transfer comes mostly from the high rotational speed of the disk, which results in more data coming under the head in any given amount of time.

Hard disks first appeared with 14" platters which didn't store all that much considering the bulk and high technology used. As with other mass storage technology, tremendous advances have been made in track spacing density, accuracy of head positioning and number of magnetic changes per linear distance. Fourteen-inch drives can now store well over 100 *million* bytes of information, and a few of these monsters can be used with microcomputers. In fact, my first exposure to hard disks was an associate's 96 megabyte Ampex drive sold by IMS for use with their Series 5000 and 8000 computers. This particular drive uses a removable 16 megabyte cartridge combined with 80 megabytes of fixed, non-removable Winchester-type storage. This allows convenient backup, but more about this issue later.

The Ampex drive is huge and noisy, so much so that it had to be installed in a separate room to keep the operators sane. But it is fast and powerful and has been totally reliable to date. Interfacing it to an existing IMS 8000 was simplicity indeed; we just plugged it in, booted up the special software provided by IMS and off it went.

Hard disks are now available in both 5 1/4" and 8" platter sizes. These particular sizes are obviously chosen so that the physical dimensions of the drives can match the size of existing floppy drives so that manufacturers don't have to make as many changes to their physical configurations.

A Word of Caution

Both sizes are available in a variety of capacities and interfaces. Early 8" drives usually held about 10 megabytes, but now can accommodate as much as 60 megabytes or more. Similarly, 5" drives commonly hold 5 megabytes, with 10-12 megabytes now appearing as well.

A brief word of caution here: hardly a day goes by without some company announcing vastly greater storage capacity on either of the sizes. Take these pronouncements with a grain of salt. I have heard of very high storage (on the order of 40 megabytes or more on a 5 1/4" hard disk and proportionally more on 8" disks) *under laboratory conditions*. This is *not* the same thing as actually producing at reasonable yield and cost a reliable drive which can deliver such density on a day-in day-out basis. In fact, it is only rather recently that a few of the drive manufacturers have been able to deliver what has been "available" for quite a while. Don't let these inflated claims deter you from acquiring a hard disk now; many of these announcements come from start-up companies in need of financing, and the actual appearance of the drives may be many months or even years away (if ever).

Drives are available with several interfaces. One of the original interfaces was and is the SMD (storage module device) interface developed for 14" minicomputer drives. The IMS 14" drive and its Model 490 controller use this interface, as do many other systems. More recently, other standards have appeared based on Shugart and Seagate Technology specifications, and several manufacturers also offer their own designs.

In any event, by far the easiest way of adding a hard disk is to purchase a drive system produced by either the manufacturer of your system or an independent supplier who has designed his hard disk to work directly with your computer. This avoids many complexities in both hardware and software and greatly improves the chances that the hard disk system will interface painlessly and be up and running quickly.

Of course, this presupposes that your manufacturer offers such a hard disk add-on. Systems are now becoming available for several of the more popular microcomputers, especially the various TRS-80s and Apples. Some of the manufacturer systems seem rather overpriced, but the ease of interfacing may more than compensate.

Owners of sophisticated S-100 systems have a wide choice of options. Some of the system manufacturers are beginning to offer hard disk sub-systems compatible with their board sets and software, and many independent vendors offer systems claimed to be compatible with a wide range of S-100 CP/M computers. Again I would advise some caution and a great deal of research. Without mentioning any names, I am aware of several hard disk systems which *cannot* be interfaced to all S-100 systems, manufacturers' claims to the contrary. The problems generally involve different interrupt architecture, software incompatibility, conflict with boot ROM location and operation, etc.

After hearing of such difficulties, I was a bit reluctant to dive into the hard disk waters, especially since IMS did not at the time offer anything other than the large, noisy and expensive commercial 14" drives mentioned earlier (they have recently announced both 5 1/4" and 8" drives in various capacities).

My investigations led me to Micro Research, Inc. in Virginia. This company is the largest IMS dealer in the country and, unlike most retailers, maintains an extensive staff of programmers and hardware experts. They are totally familiar with the IMS 490 SMD controller and had previously interfaced it to CDC and Fujitsu high capacity Winchester drives.

The Micro Research Sub-system

Micro Research was offering a complete hard disk sub-system which used the BASF 24 megabyte hard disk drive. The BASF drive is made by the same company which has built such an excellent reputation in magnetic media for both computer and consumer applications. It is less well known that BASF also manufactures both floppy and hard disk drives.

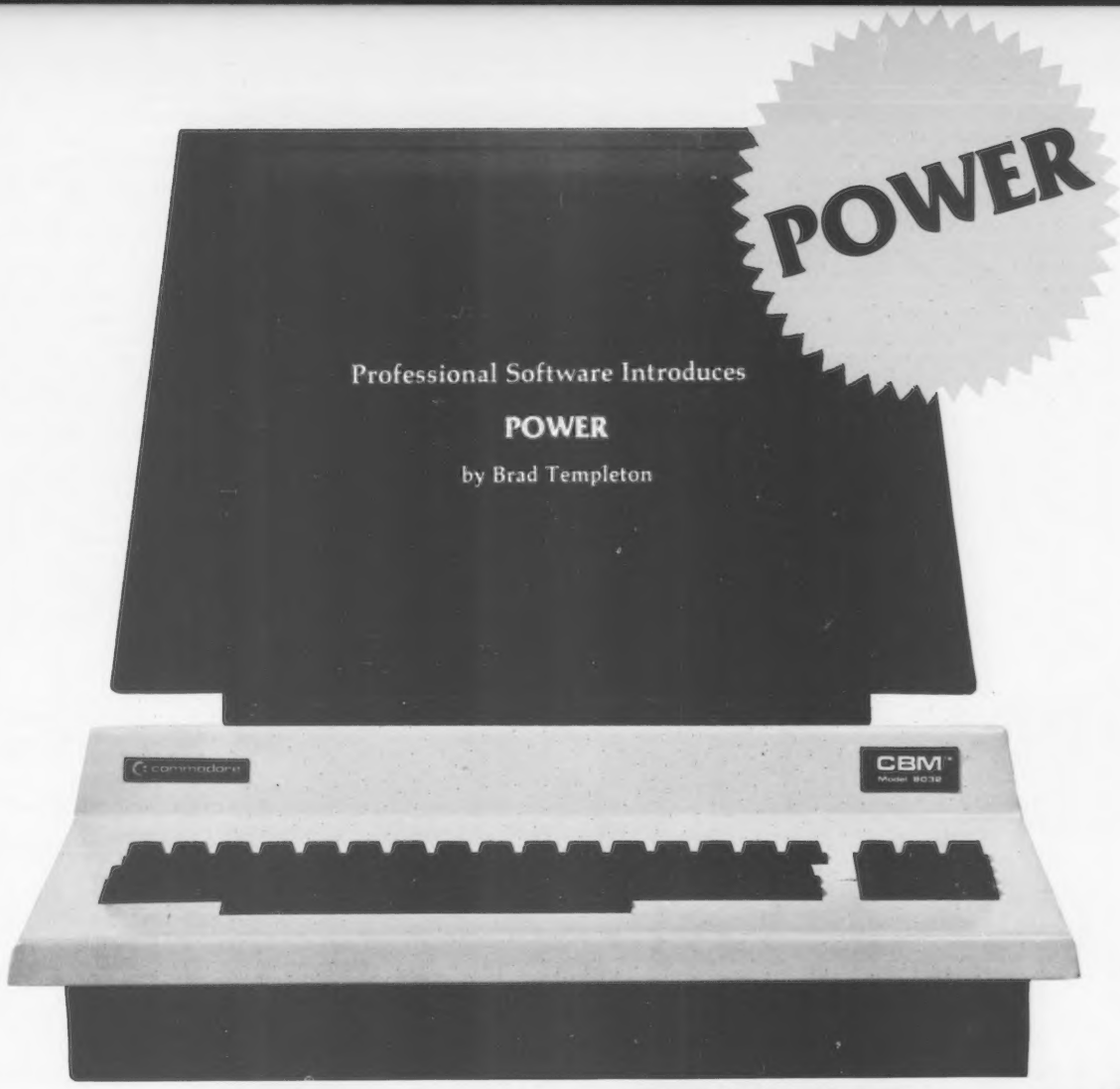
A study of specifications revealed that the BASF 24-meg drive operated much faster than many of the other available 8" hard drives through use of advanced head positioning technology. I was further encouraged to learn that this drive had been available for some time and was not a new and untested experiment. My only surprise was that BASF was so low key, concentrating their marketing efforts on large OEMs rather than on the end user. The ready availability of reliable drives at a time when many other manufacturers could not deliver seemed to merit wider recognition.

The sub-system sold by Micro Research is normally installed directly in an IBM 8000 mainframe and forms a neat, professional unit. Since I have a different configuration, I acquired the drive, cables, boot ROM, power supply and software and installed it myself in a standard 8" floppy cabinet with no difficulty.

To say that I was a bit apprehensive is a massive understatement. Micro Research's documentation was straightforward, all the hardware went together perfectly and the special utilities provided by Micro Research seemed comprehensive, but here I was several hundred miles from the source with no experience with my own hard disk. Would it work, or would I be one of the pioneers with the arrows?

The incredible happened—everything worked perfectly the first time! The for-

"I picked up that thousand-item multiple regression analysis that you've been working on for two months. Here's the output."



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matting of the hard disk surfaces proceeded smoothly, and the Micro Research system booted up without a hitch. I was sitting at a quiet, click-free computer with more storage than I had ever dreamed possible when I had started building my first computer only a few years before.

Besides the tremendous storage capacity, the performance of the system is startling. Loading the Microsoft Basic interpreter takes about a second, compared to about five seconds with a double density floppy and ten seconds with single density floppies.

Perhaps a better indication is a typical application which is heavily dependent on disk accesses. For example, a DataStar reorganization of a certain large data file required only one-fifth the time on hard disk. The difference on other programs can be still higher, with the hard disk sometimes performing eight to ten times faster than floppies. The psychological difference is even greater; the interaction with the machine is somehow totally different. Functions which seemed obtrusively slow now are comfortable. The entire computer seems faster, smoother and more professional.

Much has been made of the backup problem with Winchester drives, since fixed drives like mine don't have any removable storage. I don't find this much of a difficulty; I back up only files I have changed onto the floppy disks. Demanding professional applications can use various backup methods, including 3M tape cartridges, nine-track reel-to-reel tape drives, video-cassettes, etc.

I was sitting at a quiet, click-free computer with more storage than I had ever dreamed possible.

The hard disk system has functioned perfectly since that first day. Amazingly, it has not dropped a character, complained about long hours of operation or done *anything* other than work exactly as it should. I rarely use floppies at all except as a medium of exchange to put in new software or backup changes. I occasionally use a friend's floppy-based system, and I must really watch myself to avoid making negative comments about how slow and cumbersome it seems.

I have had several conversations with both Micro Research and BASF, and have found both organizations to be extremely knowledgeable and helpful. I certainly totally recommend the hardware system I am using. Micro Research also offers a similar system using the Konan SMC-100 controller for use with non-IMS S-100 systems. Micro Research sells the complete BASF 24-megabyte sub-system for $6995 and also offers various hardware and software elements separately for very reasonable prices.

Is the hard disk for you? Each of the mass storage methods I have discussed offers increasingly more speed, storage and convenience at higher cost. Note that the increase in cost is *not* linear. The cost per kilobyte of storage for hard disk is *much* less than that for 8" floppies, which in turn are more cost efficient than 5 1/4" floppies, etc.

If you have a floppy-based system and are becoming constrained by either the storage or speed limitations of the medium, hard disks are probably the answer. Costs will come down and storage capacities will go up, but the current state-of-the-art offers tremendous advantages that can pay dividends now. □

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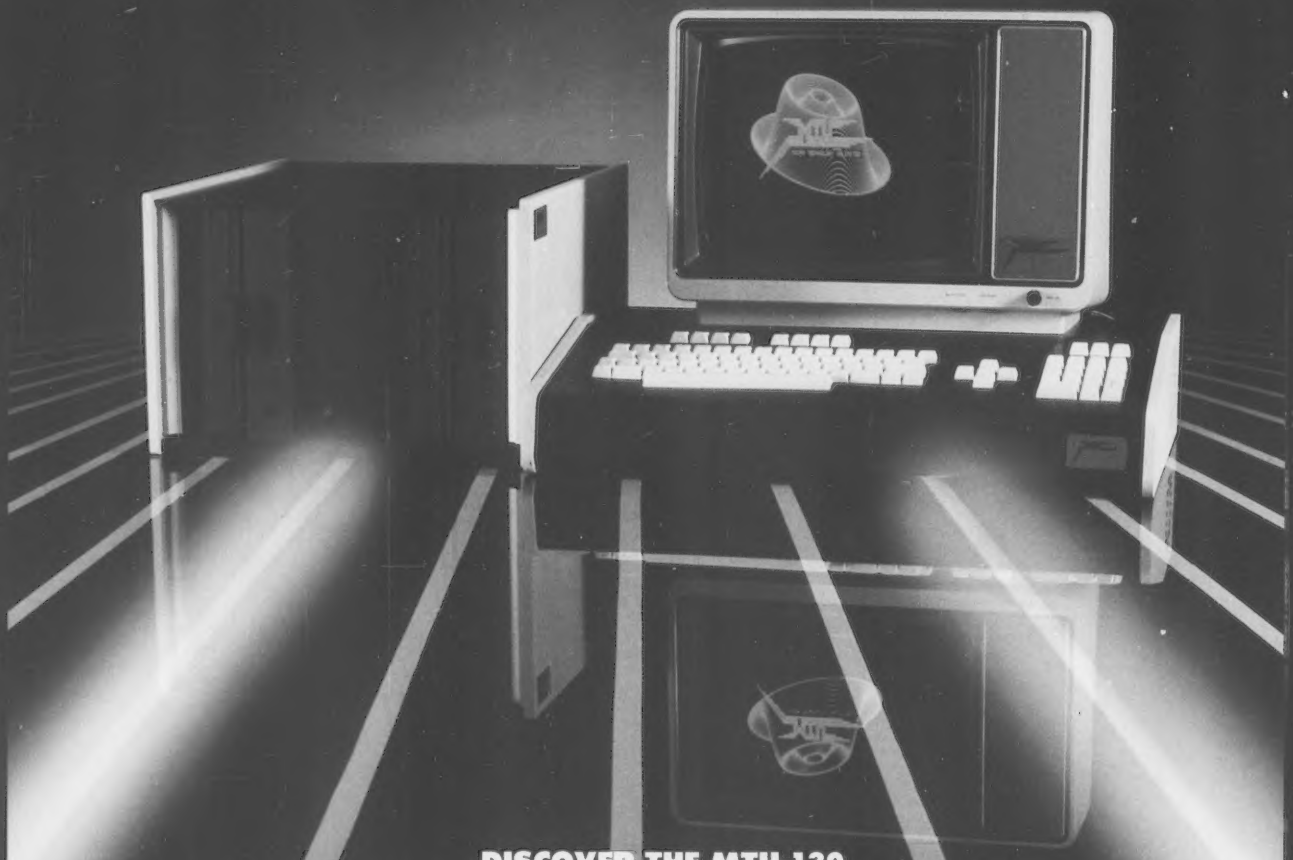

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creative computing equipment evaluation

The NEC Spinwriter

Steve Leibson

When I decided that word processing was going to be a big part of computing for my system, I started looking for an appropriate printer. Several printers had been reviewed in the computer magazines, but none seem be be ideal for word processing.

I felt that an impact printer was a must. Electrostatic and electrosensitive printers print on aluminized paper, and I really didn't want to mail my letters out on aluminum foil. Thermal printer paper fades with time and is expensive. That leaves impact printers which use plain paper and ribbons—typewriters for use with computers.

Dot Matrix Printers

Dot matrix impact printers are fast and inexpensive but their print quality is not really correspondence quality. These printers use a group of seven or nine wires which strike a ribbon leaving a column of dots on the paper. Five or seven columns of these dots are used to make a printed character.

Characters are printed by moving the head across the paper one column at a time. The appearance of the characters is similar to that of a CRT display because the characters have been formed in the same manner—with a matrix of dots. I felt that the appearance of the print from a dot matrix printer was not acceptable for letters.

Correspondence Quality

The other type of impact printer available is the "fully-formed character" printer. This type of printer is similar to a typewriter. A mechanical hammer strikes a type element, forcing it against a ribbon and leaving a mark on the paper. Fully-formed character printers offer excellent print quality. They also carry the high prices.

IBM indirectly offered one of the first fully-formed character printers for microcomputers. These were the I/O Selectrics, so named because they were designed to interface with IBM computers. Many of these printers found their way to the used equipment market. The Selectric typewriter is very common in business offices today. With the addition of a few solenoids inside, the typing element will print under computer control. There are several companies which offer conversion kits for Selectric typewriters which will transform them into printers.

The I/O Selectric offers many of the features that are desirable in word processing application. Print quality is excellent; in fact, "Selectric print quality" is the goal for which all other printers strive. There is an amazing variety of type fonts available. Changing the type font is as simple as snapping in a new print ball.

Selectric Drawbacks

There are only two problems with the I/O Selectric. First, it is very slow—only 15 characters per second. This might be satisfactory if you only do one or two single-page letters a day, but it's far too slow for computer listings or document writing.

Second, some of the modified Selectric typewriters have very sensitive adjustments. Heavy, continuous use in a computer printer application can cause the typewriter to go out of alignment, and the print quality suffers. The mechanism was designed for the intermittent use of humans, not the relentless pace of a computer.

Fully-formed character printers really became popular with the introduction of a new product by a new company. Diablo produced the Hytype I daisywheel printer in 1972. Instead of the well known IBM type ball, Diablo took the letters and placed them on plastic "petals" in a wheel configuration.

To select a character, the printer rotates the wheel until the desired print element is in front of the print hammer. The hammer then strikes the element, driving it into the ribbon and onto the paper. The print wheel has the appearance of a plastic flower, hence the name "daisywheel." There are two types of daisywheels sold today; plastic

Steve Leibson, 4040 Greenbriar Blvd., Boulder, CO 80303.

and metal. The metal wheels last longer but slow the printer down.

Qume introduced its daisywheel printer in 1974, and since then Qume and Diablo have held the largest share of the daisywheel printer market. Other manufacturers included: NEC Information Systems, Olivetti, Perkin-Elmer and Wang.

Lower Cost Versions

Recently, the price for this type of printer has been dropping rapidly. Both Xerox/Diablo and NEC have introduced lower cost versions of their original products. Pertec has introduced the Stylist 360 made in West Germany by their parent company, Triumph Adler. The Stylist 360 promises to bring the cost of full-formed character printing level with the dot matrix printers at around $1000.

NEC Spinwriter

The printer I decided on is the NEC Spinwriter. The Spinwriter uses a print "thimble" as a type element. Looking somewhat like a badminton shuttlecock, each petal has two characters on it. The thimble rotates and moves up and down to position the proper character in front of the impact hammer, which nestles inside the thimble. An NEC thimble is essentially a wilted daisywheel.

The Spinwriter knows when it has reached the end of the ribbon.

Most of the other fully-formed character printers use daisywheels, each petal of which has a single character on it. As a result of having two characters per petal, the Spinwriter has a higher print speed—a maximum of 55 characters per second. The thimble can also carry a larger number of characters, 128 as opposed to 96 for wheels.

Basic Statistics

The Spinwriter is housed in a die-cast aluminum case making a substantial machine. It weighs 51 lbs. (23.2 kg) and is large enough so that one person has trouble carrying it. The platen is 16" wide. A line of print may include up to 136 characters at 10 characters per inch or 163 characters at 12 characters per inch.

Ribbons

Three ribbons are available for the Spinwriter: nylon fabric, film, and multi-strike film. The nylon ribbon can be reused until the print is too faint to read. The film ribbon produces very crisp, beautiful print but can only be used once; when the end is reached, the ribbon is thrown away.

I usually use the multi-strike film ribbon. It produces the same high quality print as the film ribbon but lasts much longer. The reason for this is that the ribbon advances only slightly after each character is struck. Thus, each millimeter of the ribbon is reused several times. When the end of the ribbon is reached, it too is thrown away.

One of the very nice features of the Spinwriter is that it knows when it has reached the end of the ribbon. At that point, the printer will stop accepting characters from the computer and beep. It will not print again until the ribbon is changed.

If there is a handshake between the computer and the printer, no character will be lost. As soon as the ribbon is replaced and the covers closed, printing resumes where it left off.

Changing the ribbon is easy. The top cover of the Spinwriter lifts to reveal the print carriage. Two red snaps hold the ribbon cartridge. Spreading the snaps, you lift the ribbon out. A replacement ribbon snaps in. There is no threading and the operation is not messy, since you never touch the ribbon.

Interfacing

The Spinwriter connects to the computer through either a parallel or a serial interface. I have the serial type. The serial link can be set at 10, 15, 20, 30, 60 or 120 characters per second. Corresponding bit (baud) rates are 110, 150, 200, 300, 600 and 1200. Since the printer can print only 55 characters per second maximum, the higher data rates require a handshaking mechanism between the computer and the printer to prevent characters from being lost.

Handshaking over "standard" RS-232 connections is nonstandard. NEC has attempted to provide this capability without violating the standard by providing a signal on pin 19 of the interface connector to indicate that the printer buffer is full.

If the computer checks pin 19 before sending each character, and only transmits when the "all clear" is given, no data is lost. Pin 19 has been connected to a pin on my computer that can be read by the processor. A special printer driver, written in machine code, always checks that signal before sending a character. Those of you who do not write machine code can run the printer slower, use hardware that will perform the handshake automatically or find a software specialist to write you a program.

My neighbor also bought a Spinwriter, for his Apple. It is connected to a California Computer Systems serial interface card. This card is capable of handshaking with the printer over pin 4 of its serial connector. No special driver was added to that supplied with the interface.

The Spinwriter also supports a character handshake. When its buffer nears full, the printer will send either an ETX or XOFF (DC3) control character to the computer. Which character is sent is determined by a switch setting in the printer. This is supposed to be recognized as a request for a pause in the transmission until the printer catches up. When the buffer is empty, an ACK or XON (DC1) control character is sent to restart the transmission.

The feature of supporting multiple handshake protocols is important. Since there is no standard, being able to support many protocols in common use gives the Spinwriter a wider range of computers to talk to.

Type Fonts

Several type fonts are available for the Spinwriter. The latest literature lists 34 different print thimbles. Included in this list are the standard typewriter fonts Courier, Pica, Elite and Gothic. International thimbles include Kana Pica (Japan), German Elite, Canadian Bilingual, Norwegian Pica and Russian Pica.

The NEC 5525 has full typewriter keyboard so that the printer may also be used as a typewriter.

There are special optical character recognition fonts (OCR-A, OCR-B, Norwegian OCR B and Kana OCR B) and scientific fonts such as Technical Math/Times Roman. There are even two APL computer language thimbles.

Each print thimble costs about $20 and is rated at a minimum of 30 million impressions. I have never worn out or broken one.

Changing the print thimble is very simple. First, you pull up on the cover, exposing the print carriage. Moving a lever causes the print hammer to lift out of the way, revealing the print thimble. A soft vinyl locking bar at the base of the thimble is slid and rotated. Then the thimble simply lifts out. Replacement is equally simple; just reverse the procedure.

Perfect Pitch

Many of the above type fonts are available in either 10 or 12 pitch. The Spinwriter can not only print in 10 or 12 pitch but has proportional spacing as well if your software can take advantage of it.

Using The Spinwriter

Either a rubber friction-feed platen or a tractor feed mechanism moves paper

NEC's new letter-quality printer gets personal with IBM.

The Spinwriter® 3550 lets the IBM PC get down to business.
NEC's new Spinwriter letter-quality printer is the *only* one plug-compatible with the IBM Personal Computer. So you get the business applications you've been wishing for. Letter-quality output for word and data processing. Multi-language, scientific, and technical printing. Simple forms handling. Quiet operation. And the reliability of the industry's most popular printer line.

NEC designed the new Spinwriter especially for the IBM PC. It comes complete with documentation and training materials to fit your PC user's handbook. Just plug the Spinwriter in and your PC instantly becomes more versatile and flexible.

More than 8 forms handlers and 50 print thimbles boost PC versatility.
NEC designed the Spinwriter's 8 modular forms handlers to accommodate a wide range of paper and document sizes and types. The easily mounted handlers let your computer print out the forms you need for data processing, word processing, graphics, accounting or other business applications.

The Spinwriter's 50 print thimbles can more than triple your PC's usefulness. They come in both constant pitch and proportional-spaced fonts, plus in foreign language, technical and scientific versions. They snap in and out in seconds, and let you print up to 203 columns on 16-inch paper. They each last for more than 30 million impressions.

This printer's special features make everything look better on paper.
The Spinwriter's software-invoked features include automatic proportional spacing; bidirectional, bold and shadow printing; justification; centering; underscoring; and sub/super scripting, all at speeds up to 350 words per minute.

That big extra, Spinwriter reliability.
The new 3550 is part of NEC's renowned Spinwriter family, the world's most popular line of letter-quality printers.

Spinwriters have the industry's best mean-time-between-failure rating, in excess of 3,000 hours. In terms of average personal computer usage, that's more than five years.

NEC Information Systems, Inc.
5 Militia Drive, Lexington, MA 02173

Send me more information on the Spinwriter 3550.

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Title

Company

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NEC
NEC Information Systems, Inc.

CIRCLE 203 ON READER SERVICE CARD

through the Spinwriter. Paper may enter either from the back or through a bottom slot. A sensor determines when paper is out and signals the computer to stop transmitting.

Usually, printing may go on unsupervised. I have only seen the paper jam when the machine was misloaded. If the ribbon or paper runs out, the Spinwriter stops and beeps to get your attention.

My Spinwriter is the Model 5525, which is programmed to accept the control sequences of a Diablo/Xerox printer. My neighbor's is the 5510 which accepts NEC control sequences. You need to know which sequences your software will generate in order to pick the correct model. Since both the NEC and Diablo printers are popular, most word processing software packages will handle both printers, but it is best to check before buying.

Even A Keyboard

The NEC 5525 has a full typewriter keyboard so that the printer may also be used as a typewriter. Typing on the Spinwriter takes some getting used to. The time between hitting a key and hearing the hammer strike is longer than that for an electric typewriter. It is possible to type, however; you just have to find the right pace. Initially, I did use this keyboard, but as my experience with the word processor grew, my use of the Spinwriter keyboard diminished.

While the Spinwriter is printing, the paper is obscured by the print carriage and ribbon. When no printing is being done, the ribbon drops down to show all characters printed. This is most useful in typing directly on the Spinwriter.

One of the better Spinwriter features is low susceptibility to static electricity. In fact, whenever I sit down at my computer, I discharge static electricity by touching the printer. It doesn't seem to affect either the printer or the computer. The alternative is discharging to the keyboard, which usually locks the computer up and forces me to reload the system software.

Features

The Spinwriter can print bi-directionally. This is somewhat faster than normal printing

Some NEC Type Fonts

```
Super Courier

ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz

0123456789!"#$%&'()=-[]{}^~\|


Courier 72

ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz

0123456789!"#$%&'()=-[]{}^~\|


Prestige Elite Legal

ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz

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ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz

0123456789!π#∫%β'()=-[]{}┐∑Ω|


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0123456789!"#$%&'()=-[]{}^~\|
```

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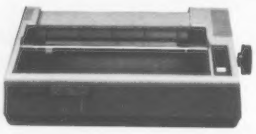

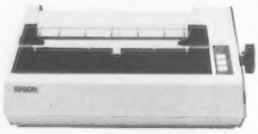

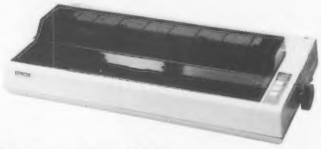

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where a line is printed followed by a carriage return and linefeed. Many word processor packages support this feature; it does speed up the printing.

Blank areas in the text are skipped. It can be amazing to watch the print carriage fly around while printing a table of figures. This definitely speeds up printing. Blank lines are treated in the same manner. The printer simply counts consecutive line feeds until a non-blank line is sent, and then the paper is rolled up to the proper spot.

Three methods of paper movement are available with the Spinwriter: friction-feed platen, pin-feed platen and tractor feed. The friction-feed platen is the familiar rubber roller used in typewriters. A pin-feed platen has drive pins added to the sides for perforations in paper designed to be fed. The tractor feed is an attachment that transforms the friction-feed machine into a pin-fed version. The advantage of the tractor over the pin-feed platen is that the tractor has adjustable width while the pin-feed platen does not. I have the friction-feed version with the tractor accessory, this a combination which has handled any printing job I have needed to do.

One feature of which I have not yet been able to take advantage is graphics. The Spinwriter can be programmed to move in 1/20th of an inch increments horizontally and 1/48th of an inch increments vertically. Fairly high resolution graphs are possible if you have the software to support this feature. WordStar uses this capability for printing super- and subscripts.

Reliability

The mean time between failures (MTBF) rating for the Spinwriter is 2000 hours, or about one year of commercial use. I do not use my printer as often as most businesses and therefore stress the printer less. The Spinwriter has never failed or missed a character. If there is a character out of position on a page, I immediately check the software or text file. You can rely on the printer that much.

There have been very few problems with my Spinwriter.

NEC has recently revised the 5500 family of printers by incorporating all the electronics onto a single circuit board to increase the reliability of the printer. The new printers are called the 7700 series and are now replacing the 5500 series.

Problems

There have been very few problems with my Spinwriter. It uses ribbons at a very high pace but I run a lot of text through it. The multi-strike film ribbons eased that problem somewhat.

Fan-fold paper has a tendency to walk across the friction-feed platen during long continuous printing, but using the tractor cures this problem.

The only feature I have found lacking in the Spinwriter is the intelligence to skip over perforations at the end of a page. My word processor is intelligent enough to do this without the printer's help, but most program listers are too dumb. They just keep printing line after line. A smart lister program is required to get a good looking listing. This happens to be a failing of most printers but not all. With the NEC's onboard microprocessor, this feature could be added.

Conclusion

I can recommend the Spinwriter without qualification. It produces excellent print, reliably and quickly. It is adaptable to almost any computer, micro or otherwise. For word processing applications, it is ideal. □

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More tips from the authors of Beneath Apple DOS . . .

Bag of Tricks™

By Don Worth and Pieter Lechner

Now there is more from the authors of the best selling book ***Beneath Apple DOS***—four comprehensive utility programs on diskette and **over 100 more pages** of valuable information about the Apple II's disk operating system.

BAG OF TRICKS is useful to beginners and experienced programmers alike. It includes many "hand holding" tutorials that assist you in repairing damaged diskettes and allow you to change sector ordering, reconstruct blown catalogs, etc. etc. etc. At the low price of $39.95, BAG OF TRICKS is one of the best software values ever.

The four programs and their functions are:

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Reach for a Star

The Starwriter from C. Itoh Electronics.

Gordon Mc Comb

Very few computer systems can be considered complete without a printer. But no one would blame you if you didn't have one or were a little shy about investing your hard earned cash in one. In many cases, a good printer can be more expensive than the computer itself.

At least, that's the way it used to be. Anyone who wanted good typewriter quality printing had to either use a typewriter or invest $3000 or so in a daisy wheel printer. The Starwriter from C. Itoh Electronics changes all that. For well under $2000, you get a well-built, reliable daisy-wheel printer that is easy to use and has many "expensive" features thrown in for free.

Hooking Up

There are actually two models of the Starwriter. One is called the Starwriter (good name) and the other Starwriter II. The only real difference between the two is speed. Starwriter II prints out at a fast 45 characters per second and costs about $300 more than the Starwriter, which prints at 25 characters per second.

You can connect the printer to your computer by either the standard Centronics-style parallel interface connection or by an RS-232C serial interface. The serial costs an additional $100.

Most systems will run without any internal modifications or changes. But there are some DIP (dual in-line package) switches located inside the printer that will allow greater flexibility and control with your particular system. They have been pre-set at the factory to interface with most personal computers. You or your dealer can readjust the machine to fit your needs.

The on/off switch is located inconveniently in the back. Therefore, if you need to turn your printer on and off manually (as opposed to a central power supply box), you can't place the machine too close to a wall or inside a cabinet—unless you have very small hands.

Other switches include on/off-line, paper advance and line advance. These are located right on the front panel along with three LED indicators for power on, paper/ribbon out and on-line.

When you activate the machine, the print head travels over to its "home" position at the left side of the carriage and awaits the proper commands from your computer. The unit is automatically put on-line, ready to accept data.

Depressing the page advance button and turning the machine on results in a test print out. This is good if you are trouble-shooting the printer or simply want to see the character set on the print wheel.

Getting Ready

The Starwriter has a friction feed roller so you can insert either continuous or single sheet paper. With the optional tractor mechanism, you can use tractor-fed forms. The tractor is especially useful when you want to print labels or bills which must be positioned exactly on the page. The tractor-feed mechanism is not included in the price of the basic machine, so if you are comparing prices, remember to take that into consideration.

The printer is capable of both 10 and 12 pitch (pica and elite) as well as proportional spacing. If you select proportional spacing, the printer will automatically compensate for the varying widths of letters—i's will take less space than w's or m's. Printing is bi-directional in 10 and 12 pitch mode, uni-directional in proportional.

The Starwriter uses print wheels and ribbons that are Diablo-compatible, so you will never be far from a supplier if you find yourself out of ink or in need of another wheel. You insert the wheel by first removing the ribbon and cocking the print mechanism back. The wheel easily snaps into place, but it is not hard to misalign it, which will cause erratic printing and possible wheel damage.

Snap the ribbon into place, and once you've got the front cover back on, you can start work.

Specifications

Print method	Static font impact system
Print rate	25 characters per second 45 characters per second (model II)
Print direction	Bi-directional (uni-directional in proportional print mode)
Character set	Standard 96-character Diablo-type daisy wheel/interchangeable
Paper feed	Friction or tractor (optional)
Interfaces	Centronics-style 8-bit parallel Standard RS-232C serial interfaces
Power requirements	90-127VAC, 60HZ, 1amp
Size	625mm x 380mm x 258mm
Weight	19.5 Kg.
List price	25 cps model - $1895 45 cps model - $2195
Optional tractor	$300
Serial interface	Add $100 (available on 25 cps model only)

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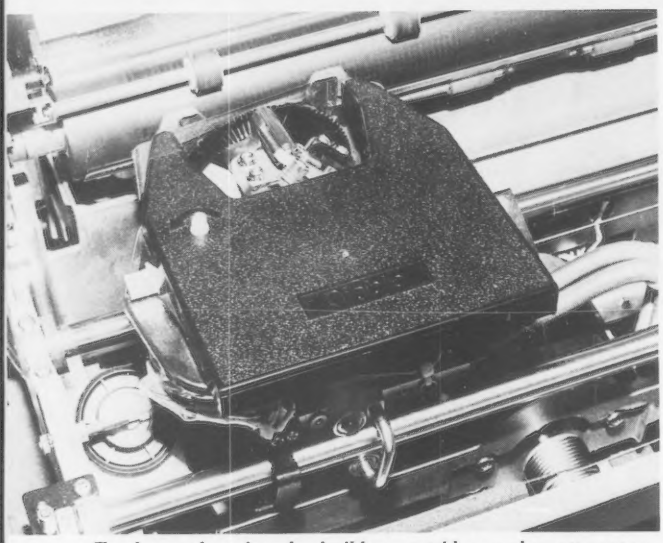
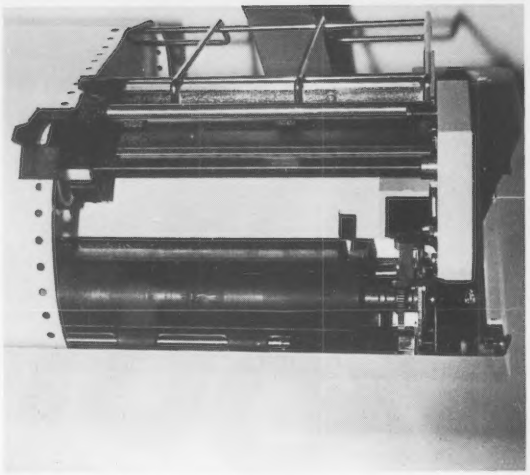


To change the print wheel, ribbon cartridge or character space setting, the entire front cover must be lifted off. A quick glance inside the machine shows it is well constructed.



The optional tractor mechanism can accomodate paper up to 15 1/2" wide and is made by TEC.

Printing Out

The Starwriter is capable of bidirectional, logic-seeking printing. The logic-seeking function tells the print head to take the shortest route to the next print position. In this way, time is not wasted as the head returns "home," then goes back to a tab position to resume printing.

Boldface and underlined characters are standard with the Starwriter, but, of course, your software must be able to access these features. The manual gives some sketchy information on special function codes. When in doubt, consult the dealer.

Because the printing platen is stepless, the Starwriter can produce intricate graphics. Pictures can be drawn with any of the 96 characters found on the print wheel.

The manual supplied with the machine covers the operation and programming details briefly. It has a very nice section on unpacking the machine from the box, but nothing on troubleshooting and very little on advanced operation. It is clearly written by computer engineers for computer engineers. It's not that it's hard to understand—it's just confusing.

The Starwriter is not the quietest of printers, but it is not the noisiest, either. The plastic cover helps a bit, but it would be a good idea to locate the printer on an outside wall if you are into late-night work.

The plastic cover is very susceptible to scratching and breaking. The front of the cover scrapes against the inside lip of the well opening and can create an unsightly smudge across its entire length. But that won't affect the printing.

A fellow Starwriter user of my acquaintance is still in a bad mood after breaking the entire plastic cover off. When open, it hangs over the front of the machine, and any reaching over or careless movements will take it off in a flash.

There is no user adjustment for the hammer strike mechanism. There is no way to lighten or darken the print. I have found that although I was able to match the type fonts of my IBM Selectric and with that of the printer, the Starwriter impression is much darker, and matching is impossible. Other printers, like the Radio Shack Daisy Wheel can be adjusted and matched perfectly.

After printing about ten pages with an imitation Diablo multi-strike ribbon, it suddenly flew off its bed.

Fitting the print wheel in place, as I mentioned, is not difficult; getting it back off is the hard part. It is somewhat difficult to remove the wheel, and since it is plastic (the Starwriter will not accept the metal variety), it is easy to slip and snap off one of the petals. I have found that gentle talk, and an even gentler, but persistent tug works quite well.

Disadvantages

There are two problems that I understand are not common to all Starwriters, but my machine has both problems.

One is that many of the capital letters are printed slightly lower than the rest of the text. There is a small adjustment that a qualified dealer or service center should be able to make to correct the problem. The capital and lower case letters are on opposite sides of the wheel. If the wheel or spindle is slightly off, the type may be uneven.

The other problem apparently occurs less frequently, but is equally disturbing. The ribbons come in either cloth or a mylar type multi-strike version, which is heavier and bulkier. After printing about ten pages with an imitation Diablo multi-strike ribbon, it suddenly flew off its bed. I placed it back on. It did it again. And again. Finally, I secured the ribbon in place with a rubber band.

I contacted a major distributor of the Starwriter and he too had witnessed this behavior, also with an imitation Diablo ribbon. In any case, the problem was corrected by replacing the springs that hold the clips that hold down the ribbon. This service was performed free of charge, since the machine was still under the 90-day parts and labor warranty.

These two idiosyncrasies aside, the C. Itoh Starwriter and Starwriter II are definitely well worth the money. The Starwriter is easy to use, reliable and uses easy to find Diablo-compatible supplies. Best of all, it has features found only in more expensive printers.

C. Itoh Electronics, Inc., 5301 Beethoven St., Los Angeles, CA 90066. □

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Put One Over On Your Apple

David H. Ahl

The Apple II has been on the market for several years and looks likely to remain a strong seller for several years to come. Given this stability, Apple and several other hardware manufacturers are marketing a broad array of plug-in boards for the computer. Today, it is rare for anyone who has had an Apple for more than six months not to have at least one plug-in board added on to it. More active users have three or four boards and some people have the entire computer populated with boards while others sit on the sidelines waiting their turn at being plugged in.

I was suffering from the "too many boards" problem and my Apple was suffering from overheating. Not often, but just enough to be mildly annoying. Hence, I was thinking about a fan. I liked the looks of the Super Fan II from R.H. Electronics which clamps on the left side of the Apple and matches the Apple case in appearance although the one from the Sup-R people that fits inside on the right rear also had appeal.

At the same time, I was thinking, "Gee, maybe I ought to get one of the housings that holds the disk drives and monitor since I am always changing boards around and forever moving the disk drives off the top and plugging and unplugging things."

So it was with more than passing interest that I looked over the Station II from Trace Systems when I was at the Silicon Gulch Games Faire last November. Here is an attractive unit that fits over the back of the Apple on which both the monitor and one or two disk drives can perch. It has an optional fan built in the left side of the unit, and it seemed to have several other nice features.

Station II is a molded, high impact plastic case identical in color and style to the Apple II. It fits over the rear of the Apple and projects out to each side by about two inches. Hence, it has more than enough room on top for a nine or twelve inch monitor and one or two disk drives (stacked).

Station II is equipped with three power outlets, so that cords and cables that normally clutter the area between the Apple and monitor and a power outlet are tucked neatly inside the back of the unit.

The photographs in the Station II instruction manual which show how this is done are wonderful in their clarity and neatness. Unfortunately the reality of folding up real power cords is not nearly so neat, tidy and easily done.

Also, although Station II boasts of three power outlets, one of them is used by the optional fan so that the Apple and monitor are the only thing that may be plugged in. Unfortunately, I was hoping to control the amplifier I use for the ALF music synthesis boards from the Station II, but this was not possible.

Although security was not a factor in my installation, Station II is designed to provide security in environments where it is needed. Station II may be bolted with four bolts to a desk, the Apple computer put inside and a keylock turned so that a clamp grips one of the ventilation slots of the Apple and prevents it from being moved. This same keylock turns on the power to the system. My only minor objection to this arrangement is that the Apple must frequently be jiggled back and forth in order for the clamp lock to be either opened or closed. However, in an environment where security is a factor, this objection is minor indeed.

A very nice feature of Station II is the line voltage surge suppressor which could potentially prevent the loss of a program due to a power surge. Station II also lets the user move the Apple in or out and choose the distance from keyboard to monitor that's right for him or her. I also found it convenient that Station II positions the monitor at about a twelve degree angle to the flat surface which is about right for an adult although not so good for a small child (a cushion will solve that problem, however).

The Station II literature boasts that "Your Apple is free to slide in and out which allows the user to get inside his Apple without unstacking and restacking peripherals." Strictly speaking, this is true. However, those cords that I went to so much trouble to arrange reasonably neatly when I placed the Station II over my Apple became a jumble of wire worms after pulling the Apple in and out a few times to exchange peripherals.

I could have lived with this, however the bigger problem was that several peripherals such as the ALF music boards and Aurora Videodisc interface have several cables which had to be snaked through the back of the Apple and through the underside of Station II to be hooked up to other devices. Clearly Station II was not designed to have boards such as these interchanged with any regularity. Indeed, if it were bolted down it would be almost impossible to change this kind of board and cable arrangement.

I don't wish to leave a negative impression. I like Station II. I find the absence of cords all over my work area a definite positive feature and the built-in fan has completely eliminated any overheating problems that I had previously.

Station II is available through computer retailers for approximately $129; the fan costs an additional $49. For more information, contact Trace Systems, 1928 Old Middlefield Way, Mountain View CA 94043. (415) 964-3115. □

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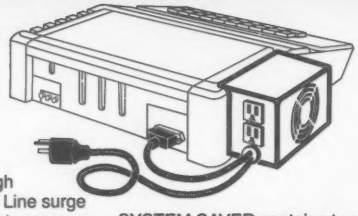

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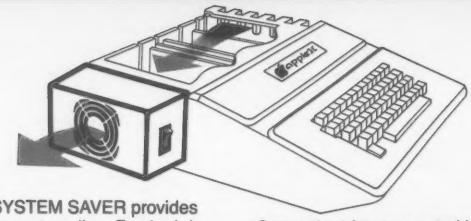

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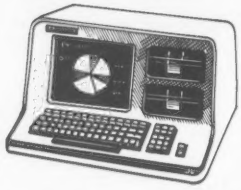

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The Atari Word Processors

Phillip Good

Word processing may not be the application of choice for the Atari 800 Home Computer, but there are many times when an Atari user would like to set words on paper in a tidy fashion.

This goal is attainable using any of the five programs described here. Unfortunately none of them offers all the features of the best of the word processors available for the Apple or the TRS-80.

Let's have a look at what is available, and perhaps you will discover the one that is best for you.

An Unfriendly Keyboard

The looks of the Atari 800 are deceptive. Superficially, the keyboard resembles that of the IBM Selectric, but the right shift key is one silly little centimeter to the right of where an experienced typist expects to find it.

The quotation mark, used constantly in Basic programs, is over the 2 rather than next to the return key. The clear screen key is where the underline should be and is too close to the end parenthesis ")" for comfort.

Corrections are made with a full-screen editor using the cursor almost as if it were a correcting pencil. But the cursor control keys on the Atari are all in shift mode; you must depress the control key each time you use the cursor.

On the other hand, the Atari does offer upper/lower case capability without hardware assists, and, unlike the Apple, the shift key is fully functional as delivered.

Like the Apple, the Atari 800 offers only a 40-column display. Unlike the Apple, no one has yet marketed an 80-column adapter. And none of the three Atari full-screen word processors makes use of the Atari high-resolution graphics to generate a 60+ column character set.

Bare-Bones Word Processors

For less than $20, either of two bare-bones word processors will allow you to use the Atari to create and edit messages for an electronic bulletin board, display them on the monitor or TV screen, store and retrieve text and programs, and produce a hard copy.

With *Letter Writer*, $19 from CE Software, you use the insert key to insert text, and the delete key to delete text errors. The program provides only two editing features of its own to let you indent paragraphs and skip lines.

The *Letter Writer* printer formatter allows you to set the line length (though not the left margin), insert new pages as required, and right justify your text. The program will operate with any parallel connected printer. I used *Letter Writer*, a $30 interface cable from Mactronics Inc., and a C. Itoh printer to prepare some reports recently.

But *Letter Writer* is still not a best buy. That honor goes to *Bob's Mini Word Processor*, which costs just $15 from Santa Cruz Educational Software.

The *Mini-Processor* allows you to create files, save or load them, modify them, and create hard copy. While editing, you have full control over the tab, delete, back space, clear, insert, and cursor control keys. But you can also advance through the text a page at a time or move with a single command to the beginning or end of the text. You may interchange "pages" of text, though you cannot cut and paste any section smaller than a page.

The *Mini-Processor* works with serial but not parallel printers, using an Atari 850 interface.

Inadequate Documentation

Ideally, any software package should include four types of documentation:

- Tutorials to get you started; the more examples and the more demonstration files, the better.
- A quick-reference manual including a detachable command reference card to keep near the keyboard.
- A comprehensive reference manual.
- Application notes for programmers.

Phillip Good is the author of *Choosing a Desk-Top Word Processor*, $21.95, from Information Research, 10367 Paw Paw Lake Dr., Mattawan, MI 49071.

Word Processors, continued...

Atari's *Word Processor* has all four, but the tutorials and reference manual are completely incomprehensible. The combined manuals are more cumbersome (and bulky) than any of the more than sixty manuals I recently reviewed. Figure 1 shows instructions for deleting a block of text from pages 31-32 of the Atari manual.

Figure 1.

Method One: Menus

A block of text can be deleted using the menu tree.

1. Repeat steps 1-4 under "Delete Next Character".
2. Recall the page that contains the text to be deleted.
3. Type E in response to the next menu prompt.
4. Press return.
5. Type T in response to the next menu prompt.
6. Press return.
7. Type S in response to the next question.
8. Press return.
9. Position cursor at the beginning of the block to be deleted.
10. Type G and press return. A right parenthesis in inverse video will appear in column one and a blank line will be inserted.
11. Position cursor after the last line of text to be deleted.
12. Type D in response to the next question.

The Atari Word Processor has the best text-editor of the three full-screen word processors.

See, it's as easy as a,b,c,d,e,f,g,h,i,j,k,l. Don't ask how to move a block of text; that takes 28 steps (Method 1). Whoever wrote this Atari manual (I think it was a committee) also wrote the mainframe manuals that drove us to using personal computers in the first place.

All three word processors—Atari's, *Letter Perfect*, and *Text Wizard*—do provide detachable quick-reference cards. *Text Wizard* has only one example, which you must type in yourself, and no demonstration files. The *Text Wizard* tutorials also serve as the comprehensive reference section—or is it vice versa? My manual was missing a page—the page that told how to save the file I had just created.

Letter Perfect has no demonstration files and only one example—a form letter. You must buy a second LJK product for another $150 to make use of the example.

Text-Editors

The Atari *Word Processor* has the best text-editor of the three full-screen word processors, if you can figure out how to use it. You can display text on the screen as it will appear in print. You can work with files much, much larger than memory. And you will automatically save what you have edited as you move from page to page. (Unfortunately, you will destroy the old text as you do so; back-up is not automatic.)

Text Wizard is the only one of the three which lets you edit programs as well as text, enter insert mode for the rapid insertion of many paragraphs of text, and move or copy entire blocks of text simply and rapidly.

Letter Perfect is the only one of the three to provide a block delete safeguard, and to let the user set tabs with a cursor.

There is an extensive list of simple editing functions that can't be done with any of the three including:

- Print one file while editing another.
- Display a second file.
- Automatically back-up on file-save.
- Insert key phrases with a single keystroke.
- Use wild cards in a search and replace command.

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Word Processors, continued...

the full-screen Atari word processors reviewed here supports the special features of a Qume or a Diablo. Atari owners must content themselves with one of two dot matrix printers—the Atari 825 (the Centronics 737 in disguise) or an Epson MX-80. The Epson is by far the better buy, even though it will not support underlining, superscripts, or subscripts.

You can't alter the number of lines per inch with any of the three full-screen word processors. You are limited to a one-line heading. You can't use soft or phantom hyphens; that means you will need to spend time printing and reformatting until you get it right. You will spend less time with the Atari word processor perhaps, because it lets you view your material on the screen just as it will appear on the printer. But the screen display is so inefficient and time-consuming, you may find it faster to use the print and guess method of *Text Wizard* or *Letter Perfect*.

None of the three lets you interrupt and resume printing, whether to answer the telephone or to pause for text entry from the keyboard. None of the three has mail-merge capability. You can get mail-merge capability for *Letter Perfect* by purchasing LJK's *Data Manager*. A mail merge option for *Text Wizard* is in the works.

A Lost Cause?

I don't think the Atari is a lost cause. With very little programming effort, one can correct its keyboard deficiencies. The cursor control keys can be reprogrammed for lower case use. This has already been done by Eastern House Software in their *Atari Monkey Wrench*. The Atari high resolution graphics can be used to create a 60+ column display without hardware assists. Both of the bare-bones word processors already support letter quality printers; there is no reason the more expensive full-screen word processors cannot provide the same support. □

Vendor's List

Bare-Bones

Bob's Mini-Word ($15), Santa Cruz Educational Software, 155425 Jigger Dr., Soquel, CA 95073. (408)476-4901.

Letter Writer ($20), CE Software, 238 Exchange St., Chicopee, MA 01013. (413)592-4761.

Full-Screen

Letter Perfect ($140), LJK Enterprises, P.O. Box 10827, St. Louis, MO 63129.

Text Wizard ($99), DataSoft Inc., 19519 Business Center Dr., Northridge, CA 91324. (800)423-5916.

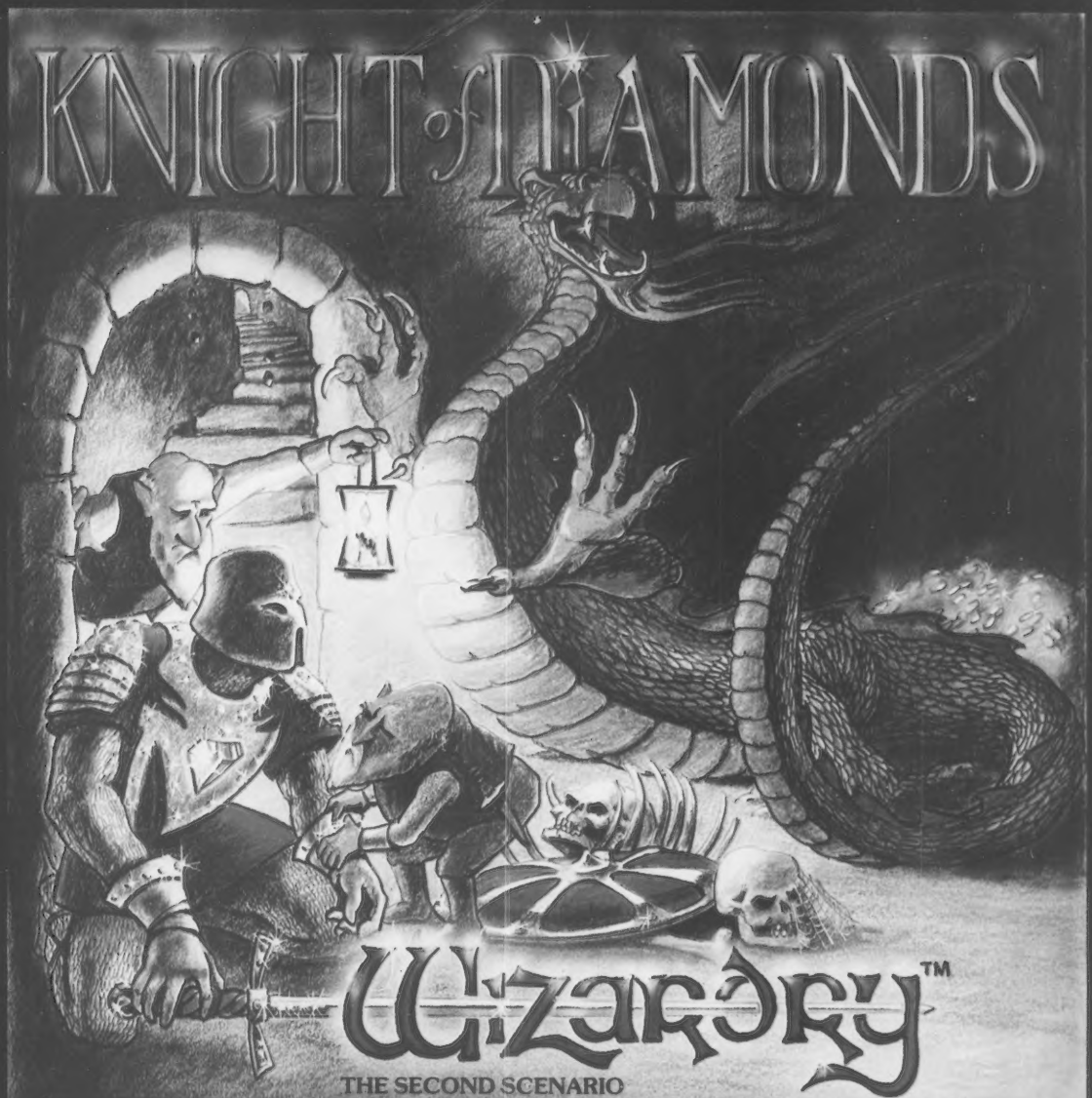
Word Processor ($150), Atari Inc., 1265 Borregas, Sunnyvale, CA 94086. (800)538-8543.

These tables were extracted from *Choosing a Desk-Top Word Processor.*

Table 1. Atari Text Editor.

	Atari WP $150	Letter Perfect $140	Text Wizard $99
Overall			
years on market	1/2	1/2	1/2
back-up	no	$20 by mail	$5 by mail
uses Hi-Res graphics	no	no	no
menu driven	yes	yes	no
can display multiple files	no	no	no
displays text on screen as it will appear in print	yes	no	no
can print one file while editing another	no	no	no
handles files larger than memory	yes	no	no
can edit programs as well as text	no	no	yes
control characters can be customized	no	no	no
Documentation			
getting started	slow	slow	easy
tutorials	hopeless	no	no
examples	yes	none	one
help menus	cumbersome	no	no
reference material	cumbersome	yes	good
separate reference card	yes	yes	yes
File Control			
continuous back-up	by page	no	no
save file and continue editing	yes	yes	yes
automatic back-up on file save	no	no	no
file protect safeguard	yes	yes	no
insert a second file with one command	yes	yes	yes
insert a portion of a second file	no	no	no
display a second file	no	no	no
display file directory	no	yes	yes
kill file (and create space)	no	yes	yes
can prepare files for transmission	no	no	yes
Scrolling (or cursor movement)			
by word	no	no	no
by line	yes	yes	yes
by sentence	no	no	no
by screen	yes	no	yes
to beginning or end of workspace	yes	yes	yes
to beginning or end of document	yes	no	no
horizontal scroll	yes	no	no
Delete			
by word	yes	no	no
by line	yes	yes	yes
by sentence	no	no	no
delete recover	yes	no	no
by screen	yes	no	no
by block	yes	yes	yes
block delete safeguard	no	yes	no
continuous delete	no	yes	no
Insert			
keyphrases	no	no	no
typeover (fast)	yes	yes	yes
insert mode (for many words)	no	no	yes
push ahead (for one or two letters)	yes	yes	yes
split and glue a line at a time	no	no	no
intermediate buffer	yes	yes	no
block whole sections	complex	no copy	yes
delete and restore	yes	yes	no

KNIGHT of DIAMONDS



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David Lubar, *Creative Computing*

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. . . perhaps the most advanced adventure program on the market.
Forest Johnson, *The Space Gamer*

The amount of detail is fantastic.
Neil Shapiro, *Popular Mechanics*

Knight of Diamonds, a challenging scenario for experienced *Wizardry* players (13th level characters will barely survive!).

Proving Grounds of the Mad Overlord (shown at right) and *Knight of Diamonds* operate on **any** Apple Computer* with at least 48K, DOS 3.3, and 1 disk drive.

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- ☐ ☐ store 596 K bytes on a floppy disk?
- ☐ ☐ talk to a Cameo cartridge disk system?
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Table 1. continued

	Atari WP	Letter Perfect	Text Wizard
Search			
find phrase anywhere in document	yes	*	*
find with user option to replace	yes	yes	yes
find and replace n times	no	no	no
find and replace all in document	yes	no	no
find and replace all in memory	yes	no	no
use wild cards	no	no	no
ignore upper/lower case in matching	no	no	no
Screen Format			
format entire text	yes	no	no
format different parts differently	no	no	no
set line length	yes	no	no
set tabs with cursor	no	yes	no
set tabs by command	yes	no	no

* Not applicable.

Table 2. Atari Text Formatter.

	Atari WP	Letter Perfect	Text Wizard
Overall			
display on screen as it will print	yes	no	no
print one file while editing another	no	no	no
mail-merge or file-merge	no	extra $	extra $
letter quality printers supported	no	no	no
Layout			
set from a menu	yes	no	no
menu may be skipped	yes	—	—
under user control while printing	no	no	no
characters per inch	yes	yes	yes
lines per inch	no	no	no
width limitation	80	80	80
Page Control			
one line heading	yes	yes	yes
multi-line heading	no	no	no
heading and footing	no	yes	yes
page numbering	yes	yes	yes
odd/even page distinction	yes	no	no
conditional new page	yes	no	no
Text Control			
justify	yes	yes	yes
center	yes	yes	yes
phantom hyphen	no	no	no
conditional formats	no	no	no
multiple columns	yes	no	yes
reverse line feed	no	no	no
Printer Control			
underline	yes	yes	yes
bold face	yes	yes	yes
vary bold face intensity	no	no	no
super- and sub-script	yes	yes	yes
change ribbon colors	no	no	no
kerning	no	no	yes
change control characters	no	no	no
proportional spacing	yes	yes	yes
Output Control			
interrupt/resume	no	no	no
pause for text entry from keyboard	no	no	no
pause for variable entry	no	no	no
start/stop at designated page/record	yes	yes	yes
print multiple documents	no	no	yes
print multiple copies	no	yes	no

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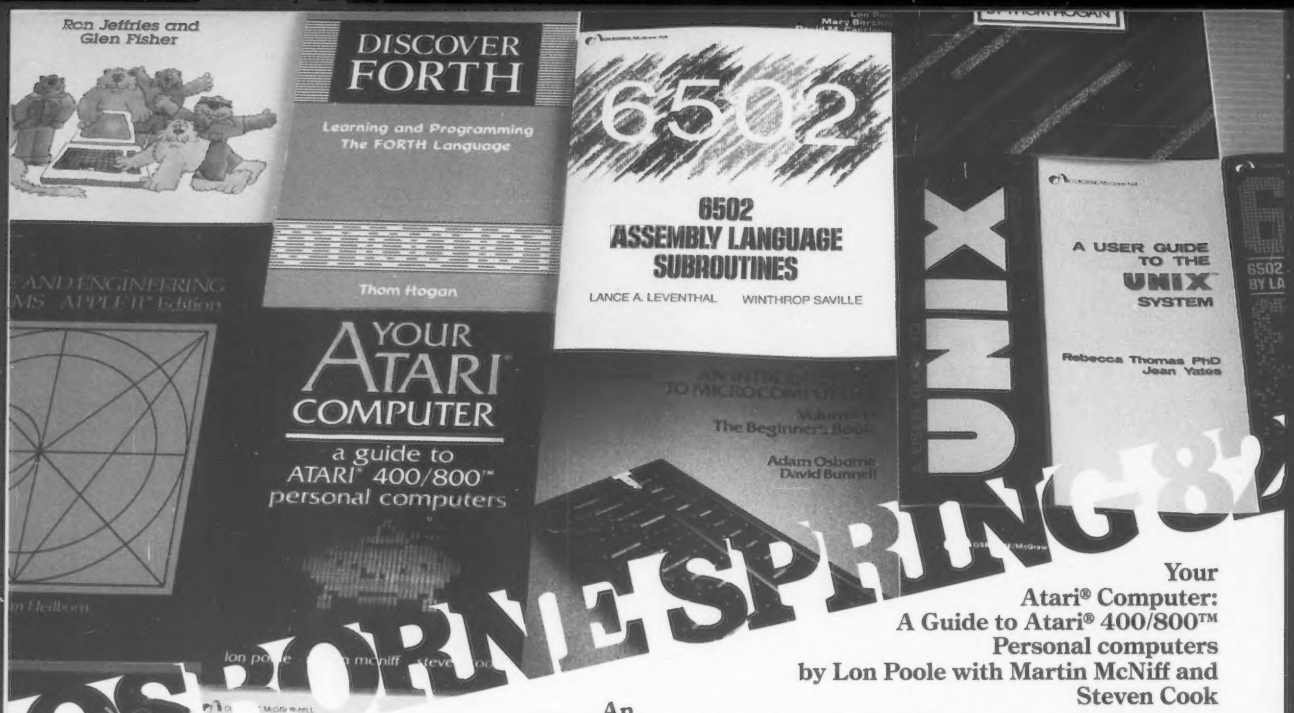

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Discover FORTH: Learning And Programming the FORTH Language by Thom Hogan

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Your Atari® Computer: A Guide to Atari® 400/800™ Personal computers by Lon Poole with Martin McNiff and Steven Cook

Your Atari® Computer provides invaluable reference material for Atari® home computer users. This "how-to" guide written for the novice covers all the common external devices, including disk drives and printers. The reader can also learn to program in Atari® BASIC. *Paper $15.00.*

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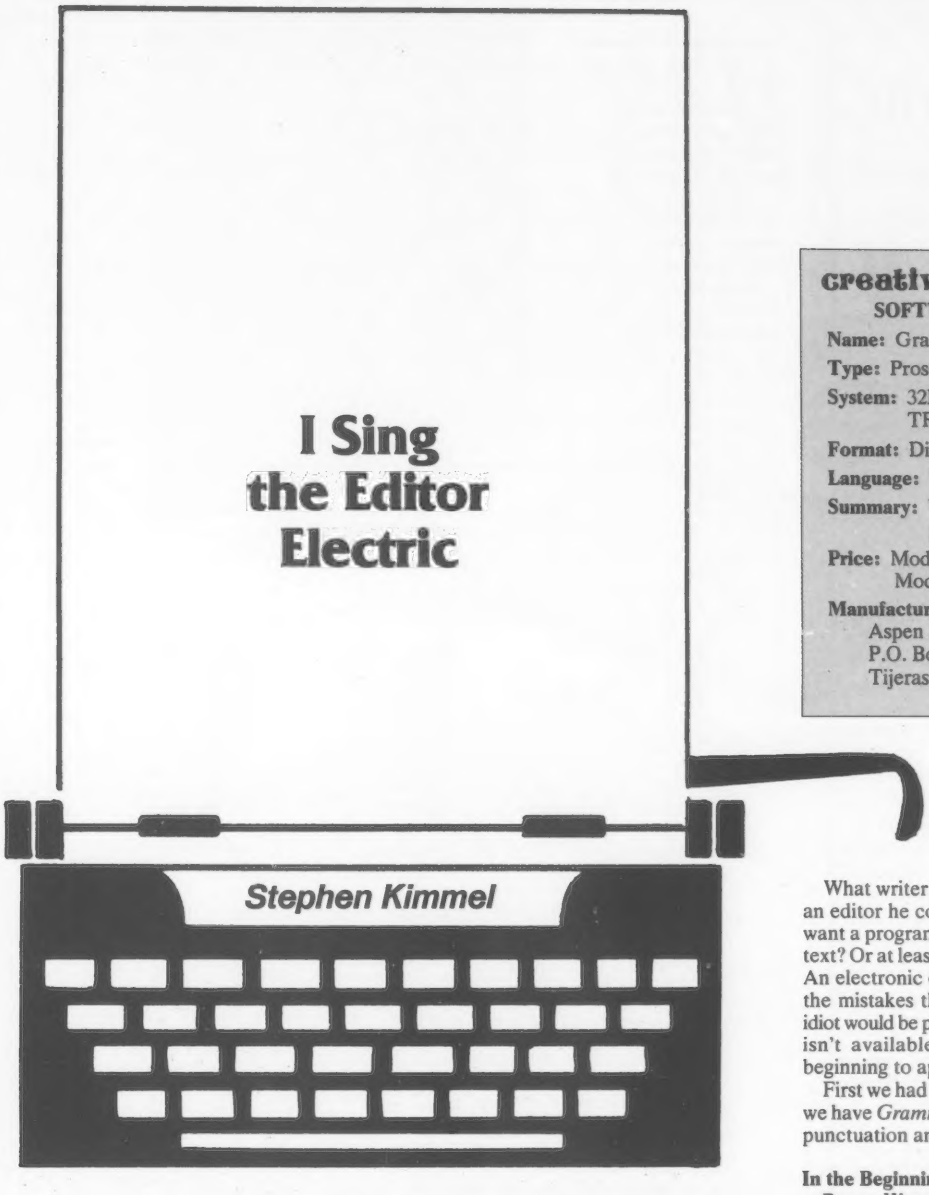
CIRCLE 216 ON READER SERVICE CARD

creative computing software evaluation

I Sing the Editor Electric



Stephen Kimmel

creative computing
SOFTWARE PROFILE

Name: Grammatik

Type: Prose editor

System: 32K Model I, II or III TRS-80, Disk drive

Format: Disk

Language: Machine language

Summary: Useful addition to word processing software

Price: Model I-$49, Model II-$99, Model III-$59

Manufacturer:
Aspen Software Co.
P.O. Box 339
Tijeras, NM 87059

Since I started reviewing software back near the dawn of time, I have seen very few programs that I thought everyone should have. I have seen many programs that were just plain bad and many programs that struggled to be adequate. I have seen several programs that were good and a few programs that I thought were extremely good. I don't get excited about many programs. The last one was *Scripsit*.

Stephen Kimmel, 4756 S. Irvington Place, Tulsa, OK 74135.

I am excited about *Grammatik*.

A short time ago (March '82) I did an article reviewing spelling checkers. I said that the proofreaders were of minimal value. After all they merely tell you which words to look up in the dictionary. Alas, spelling is only the beginning of the story. Even if all my words were spelled correctly I could still appear an idiot with my limp word choice, bad grammar, and terrible typing skills. So, while spelling is important, what I really need is something that will take care of all those other things.

What writer wouldn't give anything for an editor he could turn off? Who doesn't want a program that will turn out brilliant text? Or at least words the editor will buy? An electronic editor who would catch all the mistakes that make you look like an idiot would be perfect. Sigh. Such a program isn't available yet but the pieces are beginning to appear.

First we had the spelling checkers. Now we have *Grammatik* to check style, usage, punctuation and a little bit of grammar.

In the Beginning

Bruce Wampler, the author of *Proofreader*, sits down one day and says to himself, "Self, why can't I do the same thing for grammar and style?"

"The answer is obvious," self says to Bruce, "spelling is a piece of cake compared to checking grammar."

"Yeah, but Bell Labs is doing it with the Writer's Workbench."

"Bell Labs has a Megalith 5000 computer and 800 computer scientists working for them."

Dr. Wampler, however, is undeterred, and after long hours of labor brings forth

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+
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Spelling checking alone is not enough! No one else has anything like Grammatik! It analyzes your document for common typos, punctuation errors, misused phrases, and poor writing style. Grammatik is receiving rave reviews from both critics and users. Bob Louden in InfoWorld (12/7/81): "Grammatik is a surprisingly fast and easy tool for analyzing writing style and punctuation. If you are currently doing original writing on a word processor, you should consider this product." Eric Balkan in The Computer Consultant: "I'm impressed with the imagination that went into this product." A user: "Thanks for making my life easier!"

Grammatik and Proofreader are compatible with all CP/M, MS-DOS (including IBM PC), and TRS-80 word processors.
Current CP/M formats:
standard 8", NorthStar, Omikron TRS-80.
Please call or write for details of minimum system sizes, and availability of additional disk and operating system formats. Shipping costs included.
Please specify your system configuration when ordering. Dealer inquiries invited.
MS-DOS versions scheduled for March 1982 release.

	Proofreader	Grammatik
CP/M, MS-DOS	$129.00	$149.00
TRS-80 Model II	$99.00	$99.00
TRS-80 Mod. I/III	$54.00	$59.00

(Model I/III interactive correction option - $30.00)

Trademarks: CP/M: Digital Research; TRS-80: Tandy Corp.; Proofreader, Grammatik: Aspen Software Co.

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Grammatik, continued...

Grammatik, a program to check style and grammar. And, just for laughs, he decides to let it check for sexist terms as well.

Searching for Offenders

I can hear you now. *Grammatik* can check my grammar and style? How? *Grammatik* contains a "dictionary" of 500 commonly misused phrases. Figure 1 lists several phrases, error types and suggestions used in *Grammatik*.

The program scans through your ASCII or normal word processor document in search of these offenders. Whenever it finds one it stops and makes a suggestion.

Every time you use the word "hopefully," it will tell you that you have used a commonly misused word ("hopefully" means "in a manner that is full of hope." It doesn't mean, "it is to be hoped.") and that you should avoid it.

Every time it finds "I myself" the program will tell you that it is redundant and that "I" is sufficient. Unfortunately, the program won't check for endings that are misused. The endings "wise," "ize" and "ly" are horribly overused and can almost always be eliminated to the benefit of all. I think the next version will scan for things like this.

Probably the best way to describe what *Grammatik* does is to list the error types that the program uses. See Figure 2.

Grammatik also checks the number of sentences and words and the average length of the sentences and words. It displays the percentage of short and long sentences. Using that information, it is a simple task to calculate your "fog index." And it counts the occurrences of forms of the verb "to be" and the common prepositions.

All these are indirect measures of the readability of the document. Long sentences and long words are signs that the document is hard to understand. Too many uses of the verb "to be" indicate over-use of the passive voice, which saps the strength from a document. A high ratio of these and the prepositions indicate that the work can probably be improved by rewriting.

So far, we have seen several impressive implications for *Grammatik*. Note that *Grammatik* doesn't know anything about the meaning of words. It can't check for subject-verb agreement, dangling participles, or split infinitives.

Figure 1. A Sample of Grammatik Phrases.

"Incorrect Phrase"	Error	Suggestion
a number of	Wordy	several, many, some
ain't	Informal	revise
alas	Archaic	revise
already	Misused	already=by now
alot	Spelling	a lot
and/or	Awkward	revise
hopefully	Misused	avoid
I myself	Redundant	I
must of	Improper	must have
seldom ever	Redundant	seldom
stick to your guns	Trite	persevere
through the use of	Wordy	by, with
very	Vague adverb	avoid or revise
Xerox	Trademark	photocopy

Figure 2.

A—archaic usage
B—Unbalanced ( ) or " "
C—Capitalization error (such as "i" or "STePhen")
D—Doubled word or punctuation (and and ,,)
E—User defined error
G—Gender specific term ("laborer" instead of "workman")
I—Informal usage ("ain't")
J—Jargon or technical term
K—Awkward Usage ("and/or")
M—Commonly misused word ("eminent," "imminent," and "immanent")
O—Overworked or trite ("stick to your guns")
P—Punctuation error
R—Redundant phrase ("seldom ever" should be "seldom")
S—Spelling error ("alright" should be two words)
T—Trademark (Xerox is not a verb)
U—Improper Usage ("must of" is wrong)
V—Vague adverb ("very" adds very little)
W—Wordy phrase ("a number of" can be replaced with "several")

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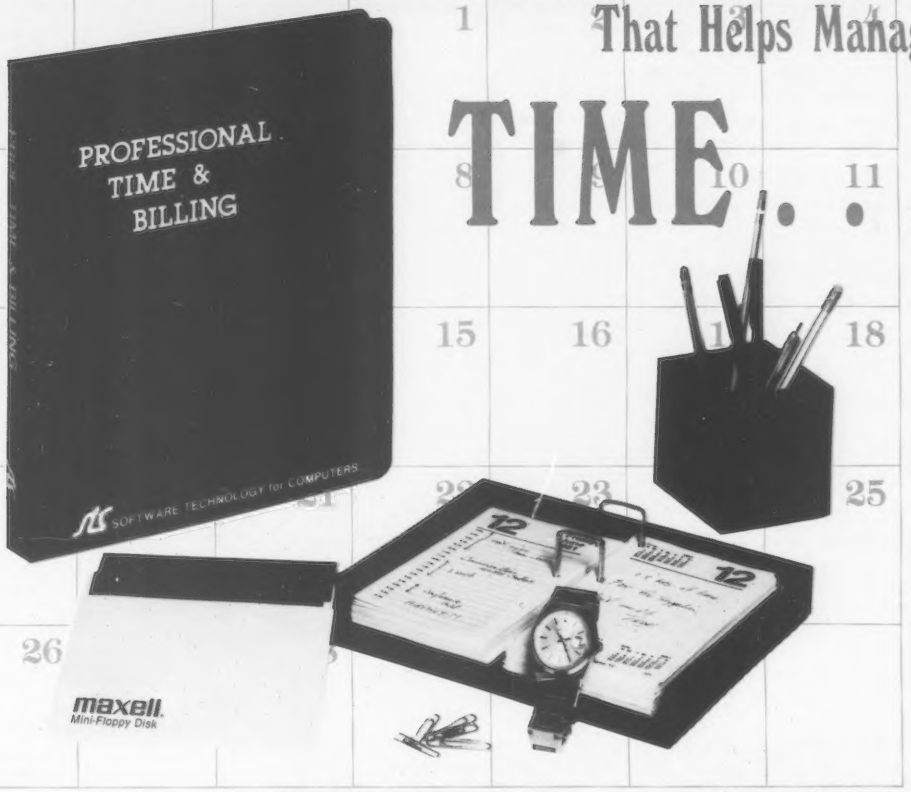

Every Minute Counts.

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The PTB program will keep accurate records of WHICH staff member performed WHAT work for WHICH client. Up to 120 user-defined rate codes of time, expenses or fixed fees can be used. Even nonbillable work and non-time-related expenses can be recorded. The program provides accurate records of monies received from clients on account or other receipts you may want to record. The PTB program will correlate all this information, assemble a comprehensive set of internal reports, and generate statements for services rendered.

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The complete package costs $395 (U.S.) and includes a 3-ring binder, program diskette and user's manual. The program will run on an APPLE II or II Plus computer with 48k, a serial or parallel printer and 2 disk drives. No other special hardware add-ons are required.

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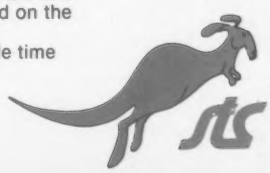

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CIRCLE 241 ON READER SERVICE CARD

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Grammatik, continued...

Of course, there are cases in which *Grammatik* will call something an error that is actually correct. This seems to be particularly true of the sexist analysis of fiction. There are cases where "his" is the correct word. Robert picked up his ball. The document must still be checked by a regular human.

The advertisement was a classic example of undersell.

Turning the Program On

The advertisement had me drooling with desire. I had to have it. So, I ordered one on Friday. Astoundingly, it arrived on Monday. I went directly to my trusty TRS-80 and began to analyze a short story of mine, "Snow Before the Summer Sun."

It is difficult to imagine the program being any easier to use. Typing GMK starts the program. It is menu driven and most of the commands take a single keystroke. D reads in the dictionary. I=SNOW told it which file to check. F= > told it to ignore the Scripsit format characters. I told it to start by typing "//."

The story began to appear on the screen. When the program found what it considered a problem, it stopped to call my attention to it and to give its suggestion. When I hit Enter, it went on. When it was finished with the story, it gave me its final analysis table as shown in Figure 3. It only took a few minutes.

I leaned back, sending my swivel chair to its farthest back position and closed my eyes. My fingertips massaged my forehead as though that would drive away the slowly creeping headache. Carefully, I glanced at the screen. The program was good. Very good. Yet there was this gnawing ache that bothered me and wouldn't go away.

Perhaps my initial expectations about *Grammatik* had brought me to this: late night, tired eyes, wishing that I was a smoker so that I could forcefully snuff out a well chewed butt. I picked up the magazine and let it fall open to the page. The advertisement said that the program would check capitalization, punctuation, doubled words and several commonly misused words. The program did all that and more. If anything, the advertisement was a classic example of undersell. I was incredulous: here was a program that didn't claim to bring heaven on earth and actually delivered more than it promised.

I lifted the soda can and found that it had been empty for hours. A quick toss in the general direction of the waste paper basket showed why the Lakers still weren't interested in me. I settled for covering my mouth with my hand.

I had expected too much from the program or perhaps too little of myself. Although I like to consider myself a professional class writer I am, in my heart, still the English student who got a "C" because the teacher was merciful. I expected the program to tell me a hundred ways to improve my story. It didn't. It found six errors and I had committed all but one of those intentionally. I expected the program to turn me into Harlan Ellison. It had told me that I was a pretty good writer already.

Figure 3. The Grammatik analysis for "Snow Before the Summer Sun."

```
Summary for SNOW / Problems detected: 5

# sent: 330 ; words: 3000
avg sent length: 9.1 ; avg word len: 4.1
# questions: 2 ; # imperatives: 4
short sent(<14 wds):270 ; long sent(>30 wds):3
longest 36 wds at #76 ; shortest 1 wds at #184
to be's: 20 ; prepositions: 188
User category totals:
NONE
```

Sitting down once again, I stared at the glowing white letters. I had decided that the program would be useful to a professional writer if only because it checks for doubled words. Considering the price, a mere $49 for the TRS-80 Model I, I could even recommend it on that basis. Don't sell your kids to get one though.

This program is like having an English teacher available to you all the time.

Who Needs It?

Who needs this program then? Where does it fit in the cosmology of computer software? It is such a nifty program that it has to be perfect somewhere. The connection dawned on me finally. This program is like having an English teacher available to you all the time. Running it on a regular basis would improve your writing skills.

Several people have reported that they receive fewer problem messages as they work with it longer. *Grammatik* would be a good choice for students and anyone who feels his writing skills could be improved. Considering the state of American literacy, that includes most of us.

I have a higher enthusiasm threshold than that. Like the spelling checkers, *Grammatik* can also be expanded to include phrases of particular significance to you. It can become your personal editor and English coach. I love to start sentences with "and." That's not a particularly good idea. So I loaded the *Grammatik* phrase dictionary into *Scripsit* and I added the phrase ".And" with the note to be careful not to overuse it. Now I get a reminder everytime I do it.

There are other words that I use too often. My copy of *Grammatik* checks for them, too, and gently tells me to watch out. I am constantly looking up "its" and "it's." Now the program stops to remind me which one is which. "Affect" and "effect" are the same way.

Grammatik has room for 300 additional phrases. That is more than enough. After three hours I added only 50 phrases. It is this utility that turned that initial evening's frustration into enthusiasm.

I like *Grammatik* a great deal. At $49, it is a worthy and useful addition to your word processing software. Now, if someone will write a program to detect dangling participles and split infinitives...Or better yet a program that will turn me into Harlan Ellison. □

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SOFTWARE PROFILE

Name: Special Delivery

Type: Mailing and form letter system

System: 32K TRS-80 Model I, II, or III, Disk Drive

Format: Disk

Language: Assembly

Summary: Excellent

Price: $125

Manufacturer:
Software Concepts
169 Preston Valley Shopping Center
Dallas, TX 75230

Special Delivery is a complete mailing system designed specifically for single or multiple disk drive TRS-80 computers. Unlike other mailing list programs that simply create one or more files that can be listed or searched on demand, *Special Delivery* provides for multiple coded "mail files," the printing of merged letters, conversion of standard Radio Shack software mailing lists into the *Special Delivery* format, and training. The training consists of three sample files for practice in preparing and using a list of names and addresses (the mailing list), preparation of merged letters, and preparation of mailing labels.

Before we go any further we'd better take time out to explain the merge process, because it is the main reason that *Special Delivery* is more than just an ordinary mailing list program.

Herb Friedman, Tridac Electronics Corp., 588 Hewlett St., Franklin Square, NY 11010.

You had to be a dummy to believe you were getting a personal letter.

If you think back to the "junk mail" you received a few years ago offering once-in-a-lifetime buys—real estate in the desert miles from water, "free" trips to vacation swamplands, and the like—you will recall that the mailer tried to personalize the letter as if you and your family were personal friends—the only ones in town to receive the offer.

Unfortunately, computer software wasn't all that good a few years ago, so the program simply dropped your name into a prewritten "computerized" format, and the letter might have looked something like the sample in Figure 1.

Obviously, with all that open space around the name and hometown you had to be a dummy to believe you were getting a personal letter.

The spaces are caused by the manner in which the letter is prepared. Because the software simply drops the name and address into a prepared text, sufficient space must be left to accommodate the longest names and addresses. Whatever space isn't used by characters appears as empty space in the final copy.

But now, with improved software, things are more precise. Word processors can merge the mailing list into the computerized letter and eliminate extraneous spaces with a "pull-up," which simply tightens up the text to the insert. Today, the same letter would appear as in Figure 2.

The letter now really looks and reads like a personal letter. If the printing is

Figure 1.

```
We are pleased to inform the          Joe Doakes
family of        Anywhere,        AK,        that
you have won a free trip to the moon.
```

Figure 2.

```
We are pleased to inform the Joe Doakes family of
Anywhere, AK, that you have won a trip to the moon.
```

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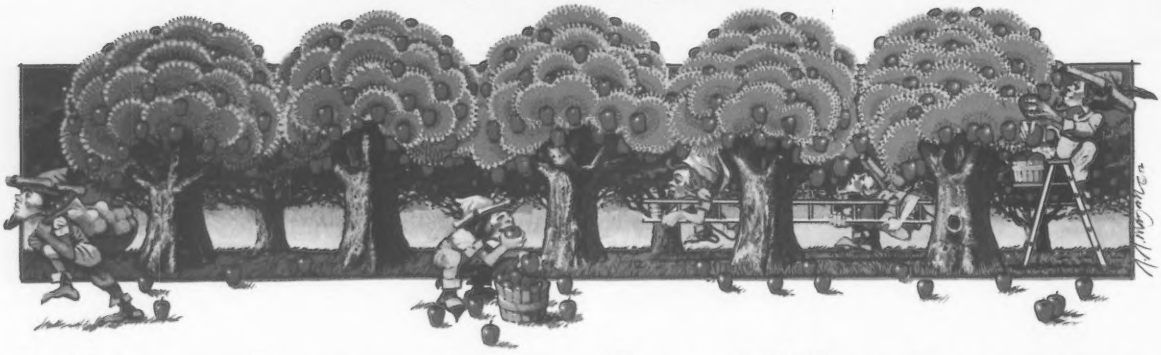

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done on a letter quality printer, no one could tell for certain whether it is, in fact, a single, personal letter, or one of several million letters which are identical except for the name and address. Keep the merge in mind as we discuss *Special Delivery*.

Special Delivery consists of three distinct programs and three sample files. The programs are: Mailform, Mailrite, and Convert (which converts Radio Shack lists to the *Special Delivery* format).

Mailform

Mailform is a stand-alone machine language program for creation and editing of name and address files (mailing lists). It runs in an overwrite mode with full cursor control that permits selective editing of data entries. If you make a spelling error when entering data you can correct only the error; there is no need to redo the entire data block.

It supports both the Electric Pencil and Radio Shack upper-/lower-case hardware, and supports the Electric Pencil control key, and the Radio Shack control, which consists of simultaneous operation of the Shift and down-arrow keys.

The functions of Mailform are activated by the control keys. A function menu with a short description of each function is displayed at all times at the right side of the CRT screen, as shown in Figure 3.

Figure 3 is an almost identical print of the CRT screen display made with the NEWDOS JKL function. The difference between Figure 3 and the actual CRT display is the underscore next to the data entry area on the left side of the screen.

Each space that can be filled with a character representing data is indicated on the CRT by an underscore. The printer shows this as a left-arrow because Radio Shack has their printers do some weird things with underscores and up-arrows (the standard exponentiation symbol).

The left side of the screen is a record, the individual entry for each person. A character can be entered only where there is an underscore; for example, all states must be identified by a standard Post Office two-letter abbreviation. You cannot use more than two letters because the program will not accept input beyond the end of the line—the last underscore on the right.

Each record has eight Data Fields, from NAME at the top through DATA 2 at the bottom. The list can be searched for information in any of the eight fields, and information in selected fields can be printed out on a list, on labels, or in a letter.

Normally, the DATA fields contain information about the individual, but they can also be used for foreign addresses. For example, assume you want to mail a letter to Canada. Even the accepted abbreviation of "CAN" won't fit in the STATE field. Also, Canada has postal codes that resemble long distance telephone numbers. You handle this situation by simply using the DATA fields. You can put the special postal code in the DATA 1 field and the country in the DATA 2 field.

Figure 3.

```
      MAILFORM -V 1.3- (C)1979 BY SPECIAL DELIVERY-WATSON
NAME     ←←←←←←←←←←←←←←←←←←←←←←←←      F - PAGE FORWARD
COMPANY  ←←←←←←←←←←←←←←←←←←←←←←←←      B - PAGE BACK
ADDRESS  ←←←←←←←←←←←←←←←←←←←←←←←←      G - GET RECORD
CITY     ←←←←←←←←←←←←←←←←←             P - PUT RECORD
STATE    ←←                            D - DELETE RECORD
ZIP      ←←←←←                         S - DEFINE SEARCH
DATA 1   ←←←←←←←←←←←←←                 C - CONT. SEARCH
DATA 2   ←←←←←←←←←←←←←                 T - SORT RECORDS
                                       R - READ FILE
RECORD # ←←←  LAST 000  MAX 188        W - WRITE FILE
FILESPEC ←←←←←←←←←←←←←←←←←←←←←←←←      X - EXTRACT FILE
                                             E - EXIT
```

Figure 4.

```
      MAILFORM -V 1.3- (C)1979 BY SPECIAL DELIVERY-WATSON
NAME     Doakes, Joe←←←←←←←←←←←←←      F - PAGE FORWARD
COMPANY  Wonder Lawn Care←←←←←←←←←      B - PAGE BACK
ADDRESS  1000 Pleasant Street←←←←←      G - GET RECORD
CITY     Anywhere←←←←←←←←←             P - PUT RECORD
STATE    AK                            D - DELETE RECORD
ZIP      55555                         S - DEFINE SEARCH
DATA 1   three children                C - CONT. SEARCH
DATA 2   rocketry←←←←←←                T - SORT RECORDS
                                       R - READ FILE
RECORD # 029  LAST 028  MAX 188        W - WRITE FILE
FILESPEC Space/B←←←←←←←←←←←←←←←←      X - EXTRACT FILE
                                             E - EXIT
```

Figure 5.

```
      MAILFORM -V 1.3- (C)1979 BY SPECIAL DELIVERY-WATSON
NAME     Doakes, Joe←←←←←←←←←←←←←      F - PAGE FORWARD
COMPANY  Wonder Lawn Care←←←←←←←←←      B - PAGE BACK
ADDRESS  1000 Pleasant Street←←←←←      G - GET RECORD
CITY     Anywhere←←←←←←←←←             P - PUT RECORD
STATE    AK                            D - DELETE RECORD
ZIP      55555                         S - DEFINE SEARCH
DATA 1   three children                C - CONT. SEARCH
DATA 2   rocketry←←←←←←                T - SORT RECORDS
                                       R - READ FILE
RECORD # 029  LAST 109  MAX 188        W - WRITE FILE
FILESPEC ←←←←←←←←←←←←←←←←←←←←←←←←      X - EXTRACT FILE
                                             E - EXIT

         ACTIVE FILE = Space/B
```

Directly under DATA 2 is the RECORD # line, which contains space for user entry of the record number for a particular mailing list, and has displays that read LAST and MAX.

LAST and MAX are controlled by the program and cannot be modified by the user. The three-digit number to the right of LAST is the Record number of the last entry. The three-digit number to the right of MAX is the maximum number of records that can be entered for a specific file (mailing list), which is determined by the amount of memory in the computer.

The program looks at the top of memory—leaving 100 bytes free for user use if desired—and calculates how many records can be included in each specific file.

Under the RECORD # line is the FILESPEC line. Here, the user enters the "code" name assigned to a specific mailing list when creating a file, and enters the file name when calling in a file from memory.

Figure 4 shows a typical entry for a record. There is the name of a person in last/first order, the company he works for, his address, how many children he has, and the family hobby (rocketry).

The RECORD # line shows that this is entry 29 in a list that already contains 28 records out of a possible maximum of 188 (the number of records for 32K of memory).

The FILESPEC line shows that this record is assigned to a file (mailing list) named (coded) "Space/B." (Space/A and Space/C, etc., would be other mailing lists of people with similar interests, because a file can contain—in this instance—only 188 records.)

Figure 5 shows how the screen appears if the Space/B file is loaded from memory. Note the line at the bottom that reads: ACTIVE FILE = Space/B. This indicates you have the Space/B mailing list in memory.

Notice that we have "paged forward" from record number one to record number 29, which is the entry we made in Figure 4. Also notice the figure to the right of LAST; it shows 109, indicating we have a total of

109 records in the Space/B file. There is still a great deal of room left in the file.

Depending on what we would like to do, we can list or print the entire list from record number one to the end, or search for specific information by the record number, or field. For example, we could search and list those people in a specific town, street or postal zone, or by DATA information.

If files are too large to fit into the available memory, they can be segmented, then edited and saved to disk under a different FILE-SPEC. Conversely, files can be chained together for continuous processing as one list.

Mailrite

The Mailrite program is designed to print letters, envelopes and labels from a mailing list created by the Mailform program. It is supplied in two versions: Mailrite/CMD and Mailrite/CEN.

The difference between the two is the type of printer with which it is to be used. Mailrite/CMD is for printers that support an underscore. Mailrite/CEN is for Centronics-type printers, which automatically linefeed when a carriage return is received, and do not support underscore.

For letter preparation, the original Mailrite text is prepared using the Electric Pencil. Special flags imbedded in the text tell Mailrite what data from the mailing list is to be substituted for the flag and merged into the text. The flags represent complete name, last name, address, state, DATA, and so forth. An example of a merged letter is shown in Figures 6 and 7. Figure 6 is a print of the original text with flags, as prepared using Electric Pencil software.

Starting at the top of the letter we have two somewhat confusing lines. These are instructions for the operator and are placed at the top of the letter where they are ignored by Mailrite. (Remember, when you use Mailrite, the top two lines don't print. If you start your letter at the top you will lose the first two lines. This also applies to envelopes and labels. The top two lines are provided so specific instructions can be included with each letter.)

The print of the letter will start with the normal DATE location, which in our form letter has the line YOUR LUCKY MONTH, DAY, AND YEAR. Then come the flags, which are indicated to the program by the less than (<) symbol. N is for the complete name, C the address, and so on. Notice how the flags are imbedded within the text of the letter.

One of the millions of recipients of this form letter will be our friend, Joe Doakes, who provided the data for record number 29 shown in Figure 5.

Figure 7 shows how the letter appears when Mailrite merges the mailing list into the text. There is absolutely no one who can say with certainty that this is a form letter from its appearance. Each bit of information about the Doakes family is correctly positioned and there are no tell-tale extraneous spaces to indicate that the letter is computerized.

After Figure 7 there is nothing more that can be said of *Special Delivery*—that letter says it all. It takes some practice to become familiar with all of *Special Delivery's* features—two to five hours for hassle-free preparation of files and imbedded flags—but the results are more than worth the time spent learning all the ins and outs of this software package. □

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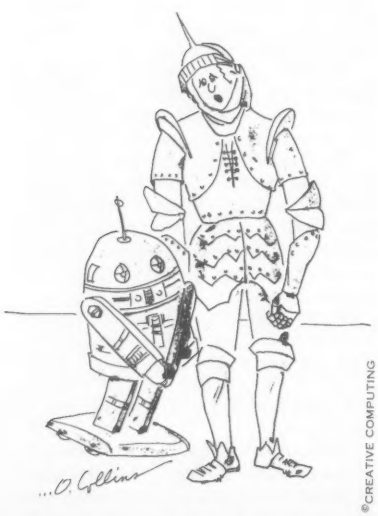
Figure 6.

```
SET TO 60 WORDS PER LINE
Form letter for moon trip. Send to families with children
YOUR LUCKY MONTH, DAY, AND YEAR
Mr. <N
<C
<A
<T, <S <Z

Dear Mr. <L:

CONGRATULATIONS to the <L family of <T, <S.  You and your <1,
all active <2 hobbyists, have won a free trip to the moon on
the first NASA passenger space shuttle.  We share the
excitement of the <L family and want to make the trip of you
<2 hobbyists as enjoyable as possible.

If you will forward $1000 as a "good faith" deposit (non-
refundable), we will insure that the <L family, of <T, <S,
will be on the first flight.

Best regards,

Bill Skybound, President
```

Figure 7.

```
YOUR LUCKY MONTH, DAY, AND YEAR

Mr. Joe Doakes
Wonder Lawn Care
1000 Pleasant Street
Anywhere, AK 55555

Dear Mr. Doakes:

CONGRATULATIONS to the Doakes family of Anywhere, AK.
You and your three children, all active rocketry hobbyists,
have won a free trip to the moon on the first NASA passenger
space shuttle.  We share the excitement of the Doakes
family and want to make the trip of you rocketry hobbyists
as enjoyable as possible.

If you will forward $1000 as a "good faith" deposit
(non- refundable), we will insure that the Doakes family,
of Anywhere, AK, will be on the first flight.

Best regards,

Bill Skybound, President
```



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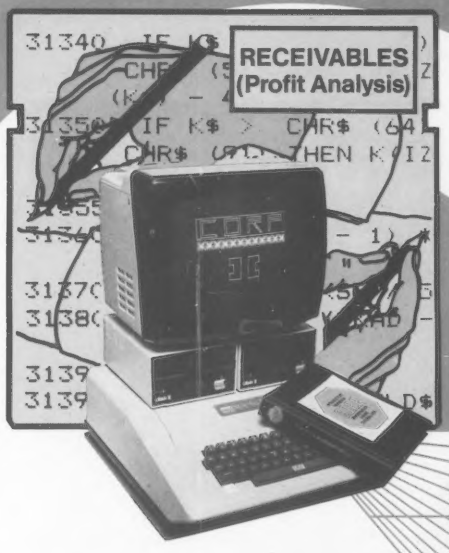
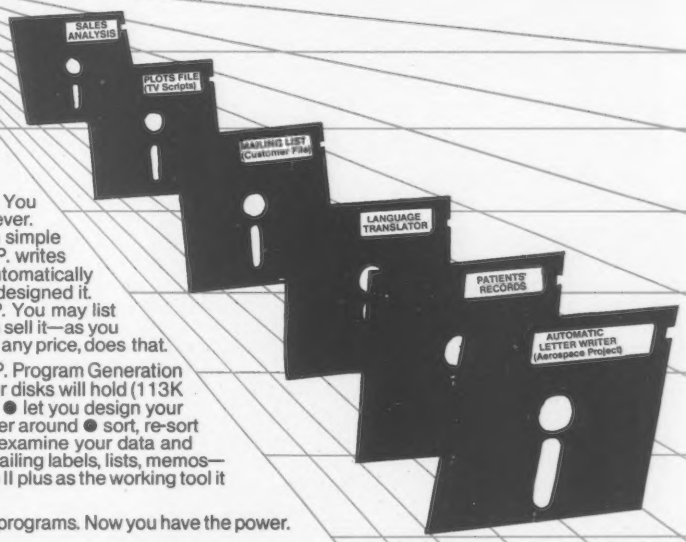


NEEDED: Apple II Plus with Auto Start, 2 drives, Applesoft in Rom, 48K.



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CIRCLE 148 ON READER SERVICE CARD

Project Planning, Scheduling, and Control

John M. Nevison

Jack Nevison is well known to Basic programmers for his earlier book, the excellent *Little Book of Basic Style: How to Write a Program You Can Read.* He presently makes his living as a consultant to corporations on executive computing needs.

Executive Computing is an introduction to using a small computer and the Basic language to meet the information processing needs of people in management. Very little knowledge of Basic is needed, and the examples in the book build on one another so that the reader moves easily from one level of complexity to the next.

Other selections of the book provide case studies and programs in inflation analysis, graphing sales, long range planning, budgeting, cost and risk analysis, information retrieval, inventory control, complex scheduling, decision analysis, and forecasting.

Appendices are provided that give an introduction to Basic programming, a number of useful utility programs, a discussion of buying a computer, and an introduction to VisiCalc.

Executive Computing is an excellent book, the material presented here is representative of the rest of the chapters.

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If one advances confidently
in the direction of his dreams, and endeavors
to live the life which he has imagined, he will
meet a success unexpected in common hours.

—Henry David Thoreau

The three product managers of Deer Division, Jean Grant, Robert Grasso, and Martin Graves, had all come up from the sales force. The general manager of the division, Eileen Randall, appreciated their marketing talent but was frustrated by their inability to plan, schedule, and control projects. At the suggestion of Steve Cauldwell, she had arranged for George Lee from the Wolf Division to come over and give a one-day seminar to her three product managers.

Lee had worked hard to prepare his presentation. He knew he would be talking to three senior managers and he wanted his material to flow smoothly. The group met in a small conference room.

"We are going to go over a technique for planning projects that are composed of several parts. I'm going to use a simple example for the sake of illustration, but together we are going to build some methods that can be used on much larger

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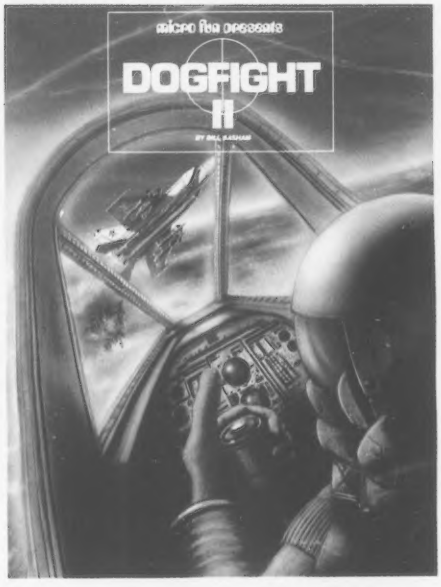

DOGFIGHT II. An established classic Arcade game. Set up a game for one to eight players each piloting a jet into combat. Play on one team, two, or against the computor.

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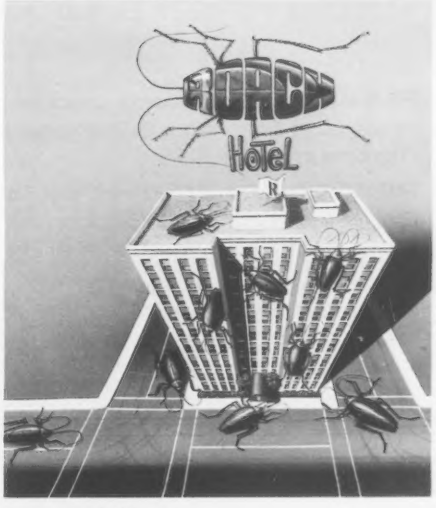

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projects. Let's keep this informal. Please interrupt at any point with questions. Our first example is the guest-cook problem.

Help with Dinner

"Suppose company is coming to dinner on Saturday night and that one guest always insists on helping in the kitchen. The guest cook retards the schedule rather than advancing it. The problem is how to use the help without delaying dinner.

"A good place to begin is with a graphic representation of the project of preparing dinner. The chart that follows is known as a Gantt chart. It's named for Henry Gantt who did quite a bit of work early in this century on how to prepare diagrams that help with project planning and control.

```
                          TIME (MINUTES)
JOB      0          50         100        150        200
         +----------+----------+----------+----------+
SHOP     IXXXXXXXXXXX
PREP     I          XXXXXX
SALAD    I          XXXXXXX
COOK     I                    XXXXXXXX
SERVE    I                              XX

LEGEND:  XXX PLANNED
```

"The chart shows five jobs, their lengths and when they happen. The jobs are: shopping for the meal, preparing the meat and vegetables, making the salad, cooking the meat and vegetables, and serving the meal. The longest job is SHOP; the shortest is SERVE. The earliest is SHOP; the latest is SERVE. (Only by coincidence are they also the longest and the shortest.) Two jobs can go on concurrently: SALAD and PREP for example. While nothing explicitly says which job follows which job, we may guess that SHOP precedes SALAD and PREP, PREP precedes COOK, and COOK and SALAD precede SERVE.

"To get a computer program to draw this picture we need to provide it with some information."

"Excuse me," said Grant, "but why do we need a computer to do this? It looks simple enough to do by hand."

"Sure, of course it is," agreed Lee. "But if we can do this small example, then we may apply the same technique to a much larger one later."

"Okay, let's give it a try," Grant shrugged.

"Here's our initial information," said Lee.

```
330       DATA BEGIN,  1,  0
340       DATA SHOP,  12,  1
350       DATA PREP,   6, 13
360       DATA SALAD,  7, 13
370       DATA COOK,   8, 19
380       DATA SERVE,  2, 27
390       DATA END,    0, 29
400 '
```

"The first number is the length of time in five-minute units. The second number is the time at which the job can start. To print out the first line of the Gantt chart we would write the following:

```
480       PRINT J$(J); TAB(11); "I";
500       FOR K = S(J) TO (S(J) + L(J) -1)
510           PRINT TAB(11+K); "X";
530       NEXT K
540 '
```

This would print out:

```
SHOP      IXXXXXXXXXXX
```

where each X equals a five-minute unit of time."

"The full program that printed out our complete Gantt chart looks like this:

```
100 REM   GANTT      30 MAY 1981   GEORGE LEE
110 '
120 REM   © COPYRIGHT 1980 JOHN M. NEVISON
          ASSOCIATES
130 '
140 REM   THIS PROGRAM PRINTS A GANTT
          CHART OF A SET
150 REM   OF JOBS IN A PROJECT.
160 '
170 REM   VARIABLES:
180 REM      J,K ..... INDEX VARIABLES
190 REM      J$()..... NAMES OF JOBS
200 REM      L()..... LENGTH OF JOBS
210 REM      N..... NUMBER OF JOBS
```


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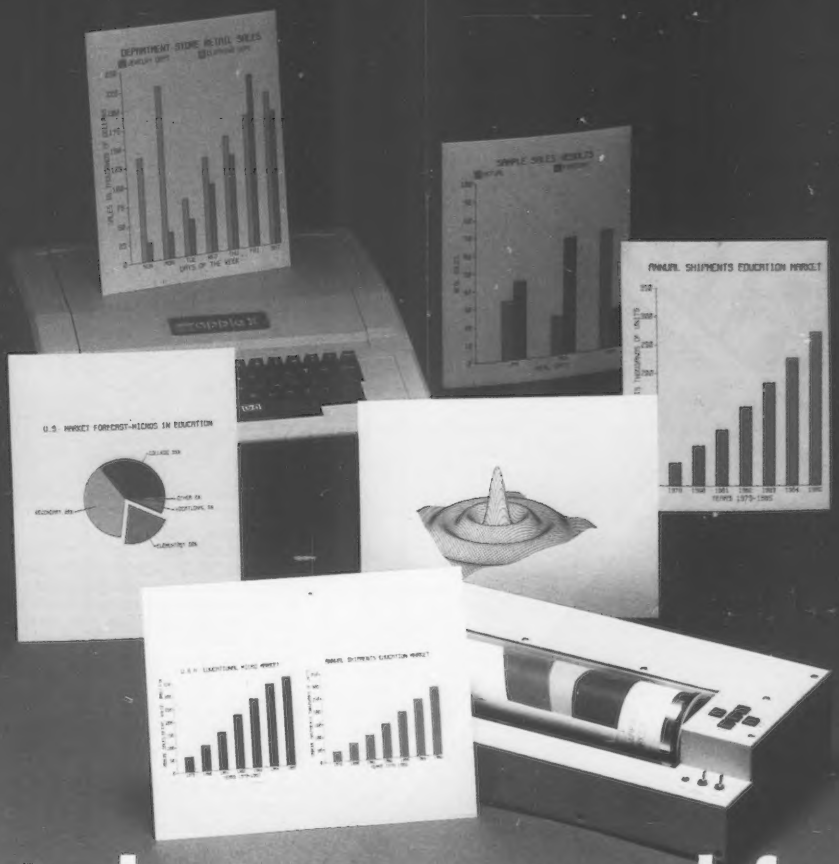

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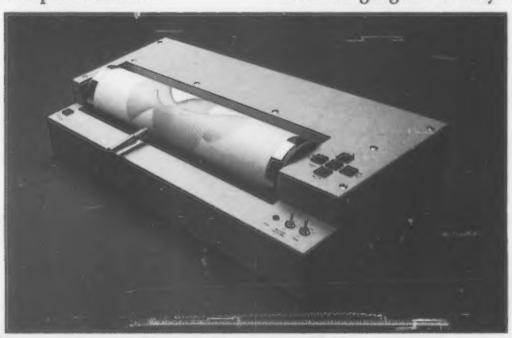

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CIRCLE 167 ON READER SERVICE CARD

GANTT, continued...

```
220 REM      S().....STARTING TIMES
230 '
240 REM   READ IN THE JOB NAME, J$(), THE JOB LENGTH,
250 REM   L(), AND THE JOB STARTING TIME, S().
260 '
270       READ N
280       DATA 7
290 '
300       FOR J = 1 TO N
310           READ J$(J), L(J), S(J)
320       NEXT J
322
325 REM   TIME IS IN 5-MINUTE UNITS
330       DATA BEGIN,    1,    0
340       DATA SHOP,    12,    1
350       DATA PREP,     6,   13
360       DATA SALAD,    7,   13
370       DATA COOK,     8,   19
380       DATA SERVE,    2,   27
390       DATA END,      0,   29
400 '
410 REM   PRINT A GANTT CHART
420 '
430       PRINT TAB(30); "TIME (MINUTES)"
440       PRINT "JOB"; TAB(11); "0        50      100      150";
445       PRINT "       200"
450       PRINT TAB(11); "+---------+---------+---------+";
455       PRINT "---------+---------+"
460 '
470       FOR J = 2 TO N-1
480           PRINT J$(J); TAB(11); "I";
500           FOR K = S(J) TO (S(J) + L(J) -1)
510               PRINT TAB(11+K); "X";
530           NEXT K
542           PRINT
560       NEXT J
570       PRINT
580       PRINT
590       PRINT "LEGEND:   XXX PLANNED"
660 '
670       END
```

"Yes, I did receive your computer billing—I gave it to my computer to pay..."

"In our case, this Gantt chart is a way of showing someone how to make dinner."

"It doesn't show that," said Grasso. "You don't learn how to cook by looking at it."

"Good point," said Lee. "I was wrong. What the chart shows is how to plan making dinner. It shows the tasks that someone must do. It shows how the components of the project are arranged in time. The shopping must be done first and will take an hour. The salad and the main course may be prepared concurrently. After everything is ready, the meal is served.

"We can also use our chart to track the project, to control it. As each job is done we tick it off the chart. Or we could draw a second line that represents the actual task, start to finish. We could alter the chart to reflect changes in the plan. New progress could be charted on the revised plan.

"Finally, because an old chart provides a history of the plan and its fulfillment, we can use the chart to improve estimates for the next project. One person takes longer than anticipated to complete a job. Certain supplies arrive sooner than anticipated. Another person does a job in half the estimated time. All these lessons can be incorporated in the next plan to make it better.

"In fact, by adding the actual start and finish of each task to our table of data, and revising our program slightly, we can get a chart that looks like this:

```
                          TIME (MINUTES)
JOB      0          50         100        150        200
         +----------+----------+----------+----------+
SHOP     IXXXXXXXXXXX
         I••••••••••••
PREP     I          XXXXXX
         I          ••••••
SALAD    I          XXXXXXX
         I          •••••••
COOK     I                XXXXXXXX
         I                ••••••
SERVE    I                      XX
         I                      ••

LEGEND: XXX PLANNED
        ••• ACTUAL
```

"Looking at the chart, we see that dinner was ready a little early because it did not take as long to cook as was anticipated. Our chart also has given us one part of the answer to our guest-cook question. Because only two jobs go on concurrently, the guest must help with one of them. So the question becomes which one?"

The Program Gantt
(Program appears earlier in text.)

Exercises
1. Revise GANTT to print the actual jobs.

From Jobs To Networks of Jobs

"To answer this question we need to know exactly how each job relates to the others. We need to sketch a network of jobs. We can draw this network for our dinner" (Figure 6.1).

"Why are the BEGIN and the END JOB on the drawing?" asked Graves.

"Because it's possible for projects to blossom into several jobs at the beginning or conclude with several jobs running in parallel. In order to begin and end the network cleanly, it is convenient to have a single entry point and a single exit point. For example, if we were to add a task called POUR-DRINKS, the task might have no predecessor but BEGIN and no successor but END.

"Looking at the network diagram you can figure out how long it will take to go from start to finish. For each job we will

set down two numbers, the length of the job and the job's earliest start:

```
                BEGIN (1,0)
                SHOP (12,1)
PREP (6,13)                    SALAD (7,13)
COOK (8,19)
                SERVE (2,27)
                END   (0,29)
```

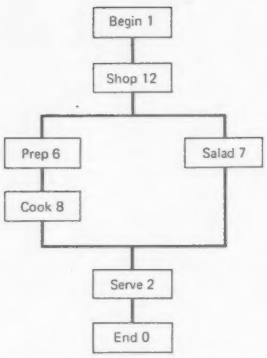

Fig. 6-1 A Network of Jobs

"Computing the early start is straightforward if you know the length of each job. Notice that SERVE must wait until the last of it predecessors, COOK is completed. SERVE waits to start until time 27. Again, time is in five-minute intervals."

"Does that mean the whole dinner took 28 units to complete and that everyone can start eating at time 29?" asked Grant.

"Yes, that's exactly right," said Lee. "Thanks for pointing that out."

"Why does BEGIN have a length of one?" asked Grasso.

"It's a trick to make all the first jobs start in interval number one. It doesn't affect anything, Good question."

"Now our example is simple enough," continued Lee, "that the next calculation may look silly, but bear with me. I'm going to start at the end and walk backwards through the network and calculate the latest possible starting time for each task. I'm going to list it as the third number inside the parentheses:

```
                END   (0,29,29) 0
                SERVE (2,27,27) 0
COOK (8,19,19) 0
PREP (6,13,13) 0       SALAD (7,13,20) 7
                SHOP (12,1,1) 0
                BEGIN (1,0,0) 0
```

"In all but one case the early and the late starts are the same. Only the SALAD has two different starts. Because the other jobs that precede SERVE take so long, SALAD could delay its start until time 20. It could start as early as time 13. The difference in the starting times is called 'slack.' SALAD has seven units of slack. The number indicating the slack is printed to the right of the parentheses.

"All the other jobs have no slack. Notice the zeros on the right of their parentheses. When a job has no slack it is on the slow path of the project. The slow path is the 'critical path' because any job delay on that path delays the whole project. The critical path for our project is SHOP, PREP, COOK, and SERVE.

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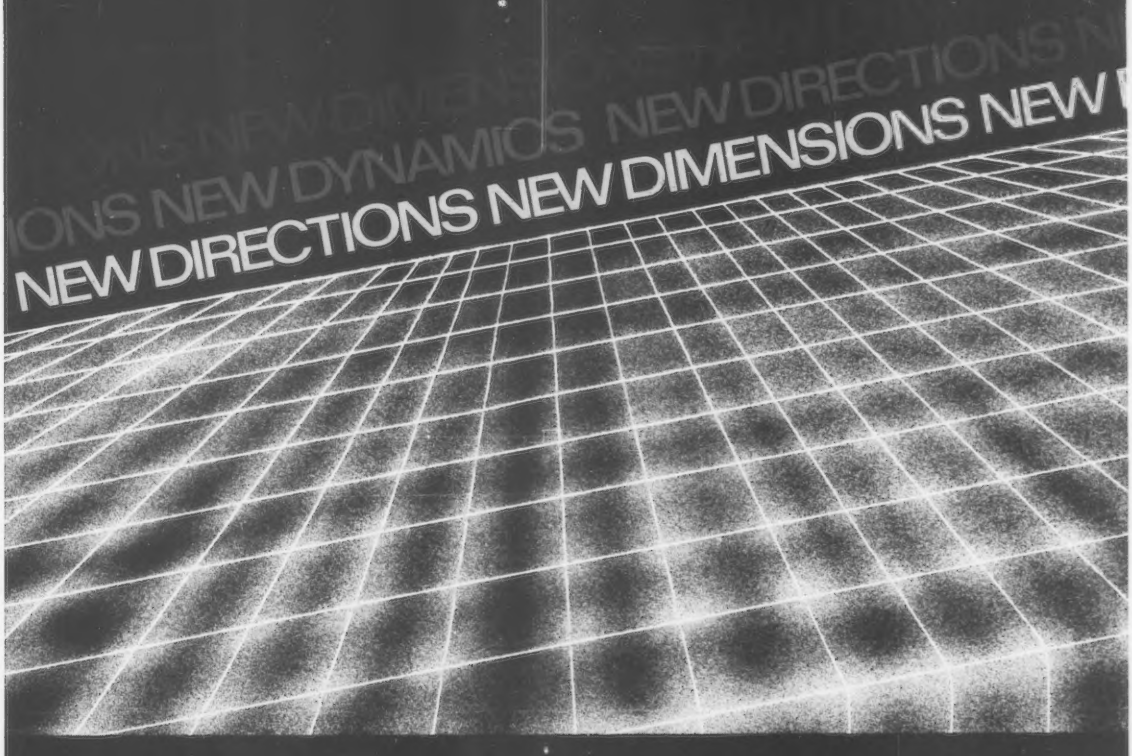

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CIRCLE 235 ON READER SERVICE CARD

"If the network of jobs were larger than in our simple example, say several hundred elements, then it would be difficult to keep an eye on all the pieces. The prudent manager pays the most attention to those jobs on the critical path. By making sure they are going well, the manager is making sure the project as a whole is staying on schedule. Of course if another job slips more than its planned slack, it may end up on the critical path also."

"Watching all this," said Graves, "could be tricky with a big project. Things could be all over the place."

The Gantt Chart Revisited

"Thank you, Marty," said Lee. "That problem leads us back to our Gantt chart.

"Can we change it somehow to pick up the necessary details of slack time and the critical path? Of course I wouldn't ask the question if the answer were not 'yes.'"

Lee showed them an enhanced Gantt chart:

```
                              TIME (MINUTES)
JOB      0          50         100        150        200
         +----------+----------+----------+----------+
SHOP     ICCCCCCCCCCCC
PREP     I          CCCCCC
SALAD    I          XXXXXXX.......
COOK     I                     CCCCCCCC
SERVE    I                               CC

TIME OF COMPLETION =  29
```

"Notice how we get this chart to tell us about how our tasks are ordered. We turn any job on the critical path into 'C's. If a job is not critical, it will have some dots after the 'X's to indicate the available slack when it starts as early as possible."

"How did the computer know what was on the critical path?" asked Grasso. "Did we give it some additional information?"

"We gave it some new information and we took out some old information," said Lee. "Most importantly, we wrote a new part of the program to have the computer figure out several things.

"Lets's begin at the end. The Gantt chart reveals each job's name, its length, its early start, and its slack."

"That means," said Graves, "that the program has to know the late start as well, because the slack is the early start minus the late start."

"That's right," agreed Lee. "But all we really need to see is the slack. The slack also gives us a clue about the sequence of jobs. The slack extends until it's time for the next job to begin, so we may infer most of the network from the diagram as it stands. We don't need anything else to manage the project. We print the numbers in a table that follows the Gantt chart:

JOB	LENGTH	STARTS EARLY	STARTS LATE	SLACK
SHOP	12	1	1	0
PREP	6	13	13	0
SALAD	7	13	20	7
COOK	8	19	19	0
SERVE	2	27	27	0

"The part of the program that prints out the table and the chart will be reviewed later. A more interesting thing to explore is the initial data that the program requires."

The Predecessor Table

"We must tell the program which jobs are connected to which other jobs. One way to do this is to announce the new job's predecessors when we introduce a new job. So the information for our dinner project might look like this:"

```
2200    DATA BEGIN, NO-MORE
2205    DATA SHOP, BEGIN, NO-MORE
2210    DATA PREP, SHOP, NO-MORE
2215    DATA SALAD, SHOP, NO-MORE
2220    DATA COOK, PREP, NO-MORE
2225    DATA SERVE, COOK, SALAD, NO-MORE
2230    DATA END, SERVE, NO-MORE
2255
```

"What's that NO-MORE mean? asked Grant. "There is no job called that."

"It's a way to tell the program that there are no more predecessors for a given job. Because we do not know in advance how many predecessors a job will have, we let the program keep reading predecessors until it finds a NO-MORE, a roadblock that says 'end of the line.'"

"A question," said Grasso, "Look at PREP. It has only SHOP for a predecessor. Why isn't BEGIN there too? It precedes PREP."

"Good question," said Lee. "Notice that BEGIN is not an immediate predecessor. You can travel back from PREP to SHOP and from SHOP to BEGIN, so immediate predecessors are all we really require to compose the network of the project.

"The program takes this information and creates a table that looks like this:

Job number I =	Job number J = 1	2	3	4	5	6	7
1	0	0	0	0	0	0	0
2	1	0	0	0	0	0	0
3	0	1	0	0	0	0	0
4	0	1	0	0	0	0	0
5	0	0	1	0	0	0	0
6	0	0	0	1	1	0	0
7	0	0	0	0	0	1	0

Fig. 6-2 A Predecessor Table

"A '1' indicates that for a job, I, the job J comes before it. So if the table is called P(), the program can look at all the Js for a given and find the P(I,J)s that are '1' and know that job J precedes job I."

"I don't think I understood that," said Graves, "Would you go over that again?"

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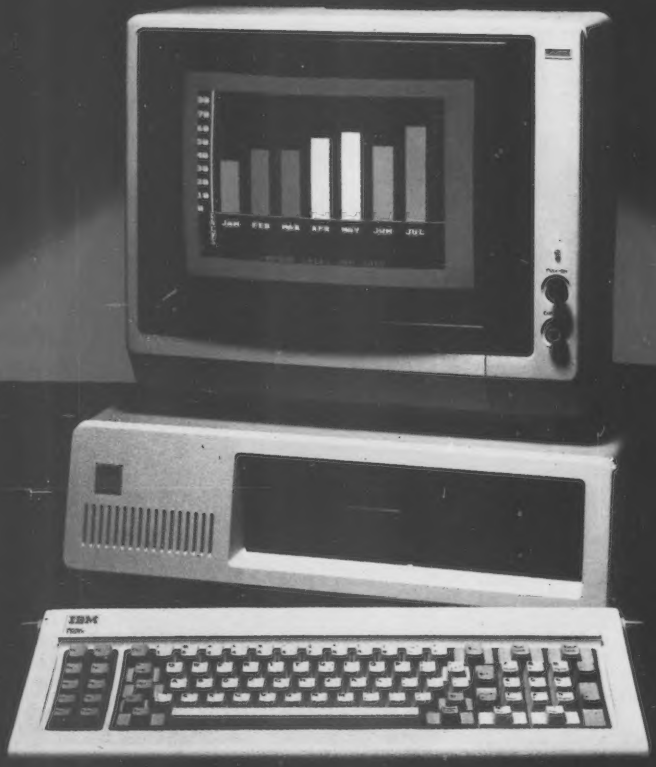

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CIRCLE 130 ON READER SERVICE CARD

"Sure," said Lee. "If you start with a row, a job, then you can look across the row and find which columns have 1s and know what the immediate predecessors of the job are."

"Okay, if that's all there is to it, then I understand," said Graves. "But let me check. Does what you just said mean that if I pick a column, I can search down it and find the jobs that follow?"

"Took the words right out of my mouth," said Lee. "That's right. So what this table gives you is an easy way, if you are a computer program, to crawl around the network.

"One advantage of having the network in the program is that we can let the program figure out the starting times. We no longer need to provide that information. The only other necessary information besides the predecessors is the length of each job. We can enter that on one line of data like this:

```
2085      FOR J = 1 TO N
2090          READ L(J)
2095      NEXT J
2100      DATA 1, 12, 6, 7, 8, 2, 0
2105 '
```

"The program itself then does what we did by hand. It computes the early starts, the late starts, and the slack. When it has this information in hand, it prints out the enhanced Gantt chart and the table."

"That program," asked Grasso, "can we get a copy of it?"

"Sure," said Lee. "As a matter of fact, we're going to spend a little while with this program right now. Each of you should sketch out a project by jobs, with the network of predecessors and the length of each job. After you get it roughed out on paper we will type it into the program and see what the results look like.

"By the way, our enhanced Gantt chart solves the guest-cook problem: we want dinner on time so we keep the guest off the critical path. Our guest cook will help by making the salad."

The Program CPM-1.

```
1000 REM   CPM-I    5 JUNE 1981    GEORGE LEE
1002 REM   CRITICAL PATH METHOD (I)
1003 '
1004 REM   © COPYRIGHT 1980 BY JOHN M. NEVISON ASSOCIATES
1005 '
1006 REM   THIS PROGRAM MAY BE USED TO FIND THE CRITICAL
1007 REM   PATH AND THE EARLIEST POSSIBLE STARTING TIMES FOR
1008 REM   A NETWORK OF JOBS.
1009 '
1010 REM   GIVEN A LIST OF JOBS, THEIR LENGTHS, AND THEIR
1015 REM   PREDECESSORS, PRINT A GANTT CHART THAT SHOWS
1020 REM   EACH JOB, "XXX"S, ANY SLACK, "..."S, AND WHETHER
1025 REM   THE JOB IS ON THE CRITICAL PATH, "CCC"S, OF THE
1026 REM   PROJECT.
1030 '
1035 REM   VARIABLES:
1040 REM      C.....COMPLETION TIME FOR THE WHOLE
1042 REM                PROJECT
1045 REM      E.....GREATEST (LATEST) END TIME
1050 REM      E() .....END TIME FOR JOBS
1055 REM      E$.....ERROR FLAG
1060 REM      I,J,K .....INDEX VARIABLES
1065 REM      J$() .....NAMES OF JOBS
1070 REM      L.....LITTLEST (EARLIEST) LATE START
1075 REM      L().....LENGTH OF JOBS
1080 REM      N.....NUMBER OF JOBS
1085 REM      P$.....NAME OF PREDECESSOR
1090 REM      P() .....PREDECESSOR TABLE
1095 REM      S() .....STARTING TIMES
1100 '
1105 REM      DIMENSIONS:
1110      DIM E(12), J$(12), L(12), P(12,12), S(12,2)
1115 '
1120 '
1125 REM   MAIN PROGRAM
1130 '
1135      GOSUB 2000      'READ IN DATA
1140      IF E$ <> "OKAY" THEN 1142 ELSE 1144
1142        GOTO 1180     'STOP
1144 '    IFEND
1145      GOSUB 3000      'COMPUTE EARLY STARTS
1150      LET C = S(N,1) + L(N)
1155      GOSUB 4000      'COMPUTE LATE STARTS
1160      GOSUB 7000      'PRINT GANTT CHART
1165      GOSUB 8000      'PRINT TABLE OF VALUES
1170 '
1175 '
1180      STOP
1185 '
1190 '
2000 REM   SUBROUTINE: READ IN DATA
2005 REM      IN: --
2010 REM   OUT: J$(), L(), N, P()
2015 '
2020 REM   READ IN THE NUMBER OF JOBS, C, THE JOB LENGTHS,
2025 REM   L(J), AND THE JOB NAMES WITH THE NAMES OF IMMED-
2030 REM   IATELY PRECEDING JOBS.  MARK THE PREDECESSOR
2035 REM   TABLE WITH A 1 FOR EVERY COLUMN JOB, K, THAT
2040 REM   PRECEDES A GIVEN ROW JOB, I.
2045 '
2050 REM   THE READER MIGHT TRY AND FILL IN THE TABLE
2055 REM   P() FOR THE FEW CASES TO SEE HOW IT LOOKS.
2060 '
2065      LET E$ = "OKAY"
2070      READ N
2075      DATA 7
2080 '
2085      FOR J = 1 TO N
2090          READ L(J)
2095      NEXT J
2096 '
2097 REM   TIME IN 5-MINUTE UNITS
2100      DATA 1, 12, 6, 7, 8, 2, 0
2105 '
2110      FOR J = 1 TO N
2115          READ J$(J), P$
2120          IF P$ = "NO-MORE" THEN 2160     'LOOP
2125              GOSUB 2280     'CHECK NAME
2130              IF E$ <> "OKAY" THEN 2135 ELSE 2140
2135                GOTO 2265    'RETURN
2140 '            IFEND
2145              LET P(J,K) = 1
2150              READ P$
2155          GOTO 2120    'LOOP
2160 '
2165      NEXT J
2170 '
2175      IF J$(N) <> "END" THEN 2180 ELSE 2190
2180        PRINT "NO END JOB"
2185        LET E$ = "NOT-OKAY"
2190 '    IFEND
2195 '
2200      DATA BEGIN, NO-MORE
2205      DATA SHOP, BEGIN, NO-MORE
2210      DATA PREP, SHOP, NO-MORE
2215      DATA SALAD, SHOP, NO-MORE
2220      DATA COOK, PREP, NO-MORE
2225      DATA SERVE, COOK, SALAD, NO-MORE
2230      DATA END, SERVE, NO-MORE
2255 '
2260 '
2265 RETURN
2270 '
2275 '
2280 REM   SUBROUTINE:  CHECK NAME
2285 REM      IN:  J, J$(), P$
2290 REM   OUT:  E$, K
2295 '
2300      LET E$ = "OKAY"
2305      FOR K = 1 TO J - 1
2310          IF P$ = J$(K) THEN 2330     'LOOP EXIT
2315      NEXT K
2320      PRINT P$; " DOES NOT PRECEDE "; J$(K)
2325      LET E$ = "NOT-OKAY"
2330 '
2335 RETURN
2340 '
2345 '
3000 REM   SUBROUTINE:  COMPUTE EARLY STARTS
3005 REM      IN: L(), N, P()
3010 REM   OUT: S(J,1)
3015 '
3020 REM   THE JOB'S EARLIEST START, S(J,1) IS JUST AFTER
3025 REM   THE SLOWEST OF IT'S PREDECESSORS HAS BEEN
3030 REM   COMPLETED.
3035 '
```

```
3040 REM    L(J).....LENGTH OF JOB J
3045 REM    S(J,1).....EARLY START TIME
3050 REM    E(J) .....END TIME
3055 REM    E.....GREATEST (LATEST) END TIME
3060 '
3065        FOR J = 1 TO N
3070            LET E = 0
3075            FOR K = 1 TO N
3080                IF P(J,K) = 1 AND E < E(K) THEN 3090 ELSE 3095
3090                  LET E = E(K)
3095 '              IFEND
3100            NEXT K
3105            LET S(J,1) = E
3110            LET E(J) = E + L(J)
3115        NEXT J
3120 '
3125 RETURN
3130 '
3135 '
4000 REM    SUBROUTINE: COMPUTE LATE STARTS
4005 REM      IN: L(), N, P(), C
4010 REM    OUT: S(J,2)
4015 '
4020 '
4025 REM    THE LATEST A JOB CAN BE COMPLETED IS JUST BEFORE
4030 REM    ITS SUCCESSOR MUST.
4035 '
4040 REM    S(J,2).....LATE START OF JOB J
4045 REM    L.....EARLIEST LATE START
4050 '
4055        FOR K = N TO 1 STEP -1
4060            LET L = C
4065            FOR J = 1 TO N
4070                IF P(J,K) <> 0 AND L > S(J,2) THEN 4080 ELSE 4085
4080                  LET L = S(J,2)
4085 '              IFEND
4090            NEXT J
4095            LET S(K,2) = L -L(K)
4100        NEXT K
4105 '
4110 RETURN
4115 '
4120 '
7000 REM    SUBROUTINE:  PRINT GANTT CHART
7005 REM      IN: J$(), L(), N, S()
7010 REM    OUT: --
7015 '
7020 REM    PRINT OUT A GANTT CHART THAT SHOWS REGULAR JOBS
7025 REM    AS "X"S, CRITICAL JOBS AS "C"S, AND SLACK ON
7026 REM    REGULAR JOBS AS "."S.
7030 '
7035        PRINT TAB(35); "TIME (MINUTES) "
7040        PRINT
7045        PRINT "JOB"; TAB(11); "0        50        100";
7046        PRINT "        150       200"
7050        PRINT TAB(11); "+----------+----------+----------+";
7052        PRINT "----------+----------+"
7055        FOR J = 2 TO N - 1
7060            PRINT J$(J); TAB(11); "I" ;
7065            LET K = S(J,1)
7070            IF S(J,1) - S(J,2) <> 0 THEN 7075 ELSE 7130
7075              IF K > S(J,1) + L(J) - 1 THEN 7095     'LOOP
7080                  PRINT TAB(11+K); "X";
7085                  LET K = K + 1
7090              GOTO 7075  'LOOP
7095 '
7100              IF K > S(J,2) + L(J) - 1 THEN 7120     'LOOP
7105                  PRINT TAB(11+K); ".";
7110                  LET K = K + 1
7115              GOTO 7100  'LOOP
7120 '
7125              GOTO 7160  'IFEND
7130 '          ELSE
7135              IF K > S(J,1) + L(J) - 1 THEN 7155     'LOOP
7140                  PRINT TAB(11+K); "C";
7145                  LET K = K + 1
7150              GOTO 7135  'LOOP
7155 '
7160 '          IFEND
7165            PRINT
7170        NEXT J
7175        PRINT
7180        PRINT
7185 RETURN
7190 '
8000 REM    SUBROUTINE:  PRINT TABLE OF VALUES
8005 REM      IN: C, J$(), L(), N, S()
8010 REM    OUT: --
8015 '
8020 '
8025        PRINT "TIME OF COMPLETION = " ; C*5
8030        PRINT
8034        PRINT "                    STARTS"
8035        PRINT "JOB    LENGTH        EARLY ";
8036        PRINT "LATE   SLACK"
8040        PRINT
8045        FOR J = 2 TO N - 1
8050            PRINT J$(J); TAB(10);L(J); TAB(25);S(J,1);
8052            PRINT TAB(30); S(J,2); TAB(40); S(J,2) - S(J,1)
8055        NEXT J
8060 '
8065 RETURN
8070 '
8075 '
8080        END
```

The gross outline of the program is revealed by the subroutines that the main routine invokes. Each subroutine performs a task in a fashion similar to the discussion in the text. To discover the details of how any piece of code works, the reader must finally take a close look at it one line at a time. Anyone who wishes to explore the workings of these subroutines should get a piece of scrap paper and do just that: work through the code and take notes.

Exercises

1. Run CPM-I on your computer and verify that the results are the same as in the example in text.
2. Draw up a network for a project of your own and enter the predecessor table and job lengths in CPM-I. Try a run.

Scheduling with a Scarce Resource

By lunch time everyone had successfully used the computer to produce an enhanced Gantt chart of a project for a Deer Division product line. All three product managers were enthusiastic about their new plans. After lunch they reassembled in the conference room.

"This afternoon," began George Lee, "we are going to help two trolls named Tread and Truss build a bridge to live under. Their problem is the same one we had this morning but with one extra feature: they have a scarce resource. The enhanced Gantt chart for their project looks like this:

```
                                                TIME-DAYS
JOB          0          10          20          30          40
             +----------+----------+----------+----------+
RIGHT PIER   IXXX.....
LEFT PIER    IXXX.....
DAM          ICCCCCCCC
CENTER PIER  I       CCCCCCC
BEAMS        I             CC
PLANKS       I               CCCCC
REMOVE DAM   I                   C
```

"So far the project looks feasible. But here's the problem. It takes two trolls to dam the stream. It takes only one troll to build a bridge pier. It takes two trolls to lay the log beams on the piers and it takes two trolls to plank the log beams. One troll can remove the dam. Their scarce resource is trolls. All of what has been said can be summed up in the following data:

JOB	LENGTH OF JOB	RESOURCE USED	START	SLACK
RIGHT PIER	3	1	9	4
LEFT PIER	3	1	12	1
DAM	8	2	1	0
CENTER PIER	7	1	9	0
BEAMS	2	2	16	0
PLANKS	5	2	18	0
REMOVE DAM	1	1	23	0

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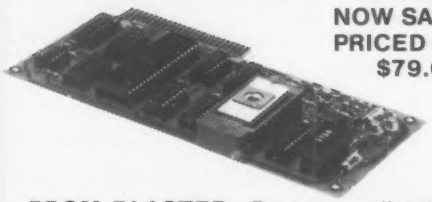

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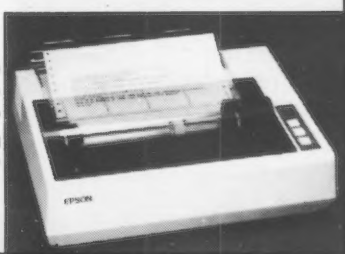

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"The resource histogram that accompanies the above data looks like this:

```
RESOURCE USED
                |***
                |***
                |********          *******
                |************************
                +---------+---------+---------+---------+
EACH ASTERISK IS  1  UNITS OF RESOURCE.
```

"The present plan requires four trolls for times 1 to 3. Only two trolls exist. They are the scarce resource. Trend and Truss looked at this situation and they delayed the start of their left and right piers to 9 and 12.

"When they ran CPM-II a second time they saw they had solved their problem:

```
                                        TIME-DAYS
JOB             0         10        20        30        40
                +---------+---------+---------+---------+

RIGHT PIER      I         XXX.....
LEFT PIER       I            XXX.
DAM             ICCCCCCCC
CENTER PIER     I         CCCCCCC
BEAMS           I                CC
PLANKS          I                  CCCCC
REMOVE DAM      I                      C

RESOURCE USED
                |
                |
                |*************** *******
                |************************
                +---------+---------+---------+---------+
EACH ASTERISK IS  1  UNITS OF RESOURCE.
```

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CIRCLE 228 ON READER SERVICE CARD


```
TIME OF COMPLETION =  24

JOB             LENGTH OF JOB   RESOURCE USED   START   SLACK

RIGHT PIER              3               1          9       4
LEFT PIER               3               1         12       1
DAM                     8               2          1       0
CENTER PIER             7               1          9       0
BEAMS                   2               2         16       0
PLANKS                  5               2         18       0
REMOVE DAM              1               1         23       0
```

"This time their resource requirements stayed within their limits. At no time did the plan require more than the two trolls they had available. The plan was a workable solution given their scarce resource. They set to work."

"What happens," asked Grant, "If part of a job takes two trolls and part of a job takes only one troll?"

"There are two ways to handle that contingency," said Lee. "First, you can say the job takes 1.5 people. If you don't like that approach, you break the job into two jobs, one with two people and one with one person."

"Is it correct to say," asked Grasso, "that you plan to run the program several times before you get it right?"

"Yes," nodded Lee.

"Then why don't you have the program do the adjusting?" Grasso continued.

"It's possible," agreed Lee, "but the program is more flexible when you stay in charge. You lose a few minutes juggling jobs, but you gain a solution that is exactly the one you want. The trolls might have a friend and decide to invite her over if they wanted to speed up the project. If she could come, they might want to shorten the length of some jobs and increase their resources to three. For example, the planking could be finished faster. The point is that the trolls retain a great deal of flexibility by using a program that keeps them in control."

"I think I hear you saying, 'Stay loose,' " said Grasso. "I'm willing to give it a try. Maybe it's not such a bad idea. I know my plans are always a balancing act. I can see how I would cycle around several times before I had just the right solution."

"We are going to do that right now." said Lee. "Each of the plans we made this morning has to be revised to include a resource. It can be dollars per week, man-days, man-hours, or anything else you wish. You have to tie some resource to each job, put in the length and start time, and look at the results. If you exceed some reasonable resource limits, reschedule some jobs and rerun CPM-II until things work."

The Program CPM-II.

```
1000 REM   CPM-II    5 JUNE 1981     GEORGE LEE
1010 REM   CRITICAL PATH METHOD (II)
1020 '
1021 REM   © COPYRIGHT 1980 BY JOHN M. NEVISON ASSOCIATES
1022 '
1030 REM   THIS PROGRAM MAY BE USED TO
1040 REM   BALANCE RESOURCE USE OF A CRITICAL PATH NETWORK
1050 REM   BY ADJUSTING THE STARTING TIMES.
1060 '
1070 REM   GIVEN A LIST OF JOBS, THEIR LENGTHS, THEIR
1080 REM   STARTING TIMES, THEIR REQUIRED RESOURCES, AND
1090 REM   THEIR PREDECESSORS, PRINT A GANTT CHART, A
1100 REM   RESOURCE HISTOGRAM, AND A TABLE OF VALUES FOR
1110 REM   THE NETWORK.
1140 '
1150 REM   VARIABLES:
1160 REM     A.....VALUE OF EACH ASTERISK IN HISTOGRAM
1170 REM     C.....COMPLETION TIME FOR THE WHOLE
1175 REM                 PROJECT
1180 REM     E.....GREATEST (LATEST) END TIME
1190 REM     E() .....END TIME FOR JOBS
1200 REM     E$.....ERROR FLAG
```

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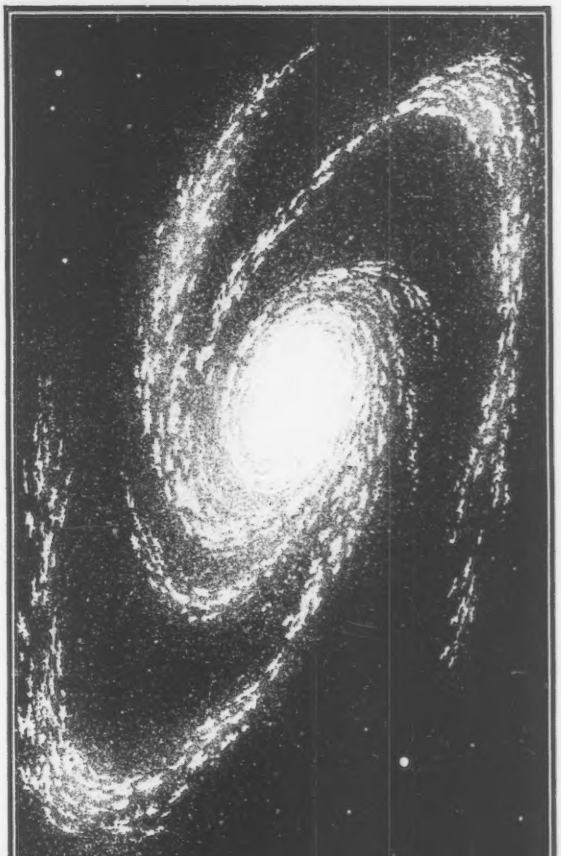
CIRCLE 204 ON READER SERVICE CARD

```
1210 REM      G$() .....GRAPH FOR HISTOGRAM
1220 REM      H() .....HISTOGRAM STEPS
1230 REM      I,J,K .....INDEX VARIABLES
1240 REM      J$() .....NAMES OF JOBS
1250 REM      L.....LITTLEST (EARLIEST) LATE START
1260 REM      L().....LENGTH OF JOBS
1270 REM      M.....MAXIMUM HISTOGRAM STEP
1280 REM      N.....NUMBER OF JOBS
1290 REM      P$.....NAME OF PREDECESSOR
1300 REM      P() .....PREDECESSOR TABLE
1310 REM      R() .....RESOURCE REQUIRED
1320 REM      S() .....STARTING TIMES
1330 REM      X.....DUMMY DATA VARIABLE
1340 '
1350 REM   CONSTANTS:
1360       LET H9 = 4          'HEIGHT OF RESOURCE HISTOGRAM
1370       LET S9 = 11         'SPACES TO LEFT EDGE OF CHARTS
1380       LET T9 = 40         'SPACES ACROSS CHARTS (TIME UNITS)
1390       LET T$ = "DAYS"  'TIME LABEL
1400 '
1410 REM   DIMENSIONS:
1420       DIM E(25), H(40), G$(10,40), J$(25)
1430       DIM L(25), P(25,25), R(25), S(25,2)
1440 '
1450 REM   MAIN PROGRAM
1460 '
1470       GOSUB 2000          'READ IN DATA
1480       IF E$ <> "OKAY" THEN 1482 ELSE 1484
1482         GOTO 1580         'STOP
1484 '     IFEND
1490       GOSUB  3000         'COMPUTE EARLY STARTS
1500       IF E$ <> "OKAY" THEN 1502 ELSE 1504
1502         GOTO 1580         'STOP
1504 '     IFEND
1510       LET C = S(N,1) + L(N)
1520       GOSUB  4000         'COMPUTE LATE STARTS
1530       GOSUB  7000         'PRINT GANTT CHART
1540       GOSUB  7200         'PRINT RESOURCE HISTOGRAM
1550       GOSUB  8000         'PRINTTABLE OF VALUES
1560 '
1570 '
1580       STOP
1590 '
1600 '
2000 REM   SUBROUTINE: READ IN DATA
2005 REM      IN: --
2010 REM   OUT: E$, J$(), L(), N, R(), P(), S()
2015 '
2020 REM   READ IN THE NUMBER OF JOBS, N, THE JOB LENGTHS,
2025 REM   L(J), AND THE JOB NAMES WITH THE NAMES OF IMMED-
2030 REM   IATELY PRECEDING JOBS.  MARK THE PREDECESSOR
2035 REM   TABLE WITH A 1 FOR EVERY COLUMN JOB, K, THAT
2040 REM   PRECEDES A GIVEN ROW JOB, I.
2045 '
2050 REM   THE READER MIGHT TRY AND FILL IN THE TABLE
2055 REM   P() FOR THE FEW CASES TO SEE HOW IT LOOKS.
2060 '
2065       LET E$ = "OKAY"
2070       READ N
2075       DATA 9
2080 '
2085       FOR J = 1 TO N
2087            READ X$, S(J,1), L(J), R(J)
2088       NEXT J
2090       DATA BEGIN, 0, 1, 0
2091       DATA RIGHT PIER, 9, 3, 1
2092       DATA LEFT PIER, 12, 3, 1
2093       DATA DAM, 1, 8, 2
2094       DATA CENTER PIER, 9, 7, 1
2095       DATA BEAMS, 16, 2, 2
2096       DATA PLANKS, 18, 5, 2
2097       DATA REMOVE DAM, 23, 1, 1
2098       DATA END, 24, 0, 0
2101 '
2102       READ X
2103       DATA -.9999
2104       IF X <> -.9999 THEN 2105 ELSE 2109
2105         PRINT "WRONG NUMBER OF DATA FOR STARTING DATA."
2106         PRINT "BE SURE TO INCLUDE STARTING DATA FOR THE"
2107         PRINT "'BEGIN' JOB AND THE 'END' JOB."
2108         LET E$ = "NOT-OKAY"
2109 '     IFEND
2110       FOR J = 1 TO N
2115            READ J$(J), P$
2120            IF P$ = "NO-MORE" THEN 2160     'LOOP
2125                 GOSUB 2280     'CHECK NAME
2130            IF E$ <> "OKAY" THEN 2135 ELSE 2140
2135              GOTO 2265     'RETURN
2140 '          IFEND
2145            LET P(J,K) = 1
2150            READ P$
2155       GOTO 2120    'LOOP
2160 '
2165       NEXT J
2170 '
2175       IF J$(N) <> "END" THEN 2180 ELSE 2190
2180         PRINT "NO END JOB"
2185         LET E$ = "NOT-OKAY"
2190 '     IFEND
2195 '
2200       DATA BEGIN, NO-MORE
2205       DATA RIGHT PIER, BEGIN, NO-MORE
2210       DATA LEFT PIER, BEGIN, NO-MORE
2215       DATA DAM, BEGIN, NO-MORE
2220       DATA CENTER PIER, DAM, NO-MORE
2225       DATA BEAMS, LEFT PIER, RIGHT PIER, CENTER PIER, NO-MORE
2230       DATA PLANKS, BEAMS, NO-MORE
2235       DATA REMOVE DAM, PLANKS, NO-MORE
2240       DATA END, PLANKS, NO-MORE
2255 '
2260 '
2265 RETURN
2270 '
2275 '
2280 REM   SUBROUTINE:  CHECK NAME AND FIND PREDECESSOR
2285 REM      IN: E$, J, J$(), P$
2290 REM   OUT: E$, K
2295 '
2305       FOR K = 1 TO J - 1
2310            IF J$(K) = P$ THEN 2330     'LOOP EXIT
2315       NEXT K
2320       PRINT P$; " DOES NOT PRECEDE "; J$(K)
2325       LET E$ = "NOT-OKAY"
2330 '
2335 RETURN
2340 '
2345 '
3000 REM   SUBROUTINE:  CHECK STARTS
3005 REM      IN: E$, L(), N, P(), S(J,1)
3010 REM   OUT: E$
3015 '
3020 REM   THE JOB'S START, D(J,1), MUST BE AFTER THE
3025 REM   SLOWEST OF ITS PREDECESSORS HAS BEEN
3030 REM   COMPLETED.
3035 '
3040 REM   L(J).....LENGTH OF JOB J
3045 REM   S(J,1).....EARLY START TIME
3050 REM   E(J) .....END TIME
3055 REM   E.....GREATEST (LATEST) END TIME
3060 '
3065       FOR J = 1 TO N
3070            LET E = 0
3075            FOR K = 1 TO N
3085                 IF P(J,K) = 1 AND E < E(K) THEN 3090 ELSE 3095
3090                   LET E = E(K)
3095 '               IFEND
3100            NEXT K
3102            IF S(J,1) < E THEN 3103 ELSE 3109
3103              PRINT "STARTING TIME"; S(J,1); " OF JOB #";
3104              PRINT J; " MUST BE LATER THAN "; E; "."
3105              PRINT "PLEASE RETYPE THE STARTING TIMES."
3106              PRINT
3107              LET E$ = "NOT-OKAY"
3108              GOTO 3125 'RETURN
3109 '          IFEND
3110            LET E(J) = S(J,1) + L(J)
3115       NEXT J
3120 '
3125 RETURN
3130 '
3135 '
4000 REM   SUBROUTINE: COMPUTE LATE STARTS
4005 REM      IN: L(), N, P(), C
4010 REM   OUT: S(J,2)
4015 '
4020 '
4025 REM   THE LATEST A JOB CAN BE COMPLETED IS JUST BEFORE
4030 REM   ITS SUCCESSOR MUST START.
4035 '
4040 REM   S(J,2).....LATE START OF JOB J
4045 REM   L.....EARLIEST LATE START
4050 '
```

```
4055 '      FOR K = N TO 1 STEP -1
4060            LET L = C
4065            FOR J = 1 TO N
4070                IF P(J,K) = 1 AND L > S(J,2) THEN 4080 ELSE 4085
4080                  LET L = S(J,2)
4085 '              IFEND
4090            NEXT J
4095            LET S(K,2) = L -L(K)
4100        NEXT K
4105 '
4110 RETURN
4115 '
4120 '
7000 REM    SUBROUTINE:  PRINT GANTT CHART
7005 REM      IN: J$(), L(), N, S()
7010 REM    OUT: --
7015 '
7020 REM    PRINT OUT A GANTT CHART THAT SHOWS REGULAR JOBS
7025 REM    AS "X"S, CRITICAL JOBS AS "C"s, AND SLACK ON
7026 REM    REGULAR JOBS AS "."S.  FOR EACH TIME, K,
7027 REM   ACCUMULATE THE JOB'S RESOURCE, R(J), IN THE
7028 REM   HISTOGRAM STEP, H(K).
7029 '
7030        FOR K = 1 TO T9
7031            LET H(K) = 0
7032        NEXT K
7033 '
7035        PRINT TAB(35); "TIME-"; T$
7045        PRINT "JOB"; TAB(S9); "0         10        20";
7046        PRINT "         30        40"
7050        PRINT TAB(11); "+----------+----------+----------+";
7051        PRINT "----------+----------+"
7052 '
7055        FOR J = 2 TO N - 1
7060            PRINT J$(J); TAB(S9); "I";
7065            LET K = S(J,1)
7070            IF S(J,1) - S(J,2) <> 0 THEN 7075 ELSE 7130
7075              IF K > S(J,1) + L(J) - 1 THEN 7095      'LOOP
7080                  PRINT TAB(S9+K); "X";
7083                  LET H(K) = H(K) + R(J)
7085                  LET K = K + 1
7090              GOTO 7075  'LOOP
7095 '
7100              IF K > S(J,2) + L(J) - 1 THEN 7120      'LOOP
7105                  PRINT TAB(S9+K); ".";
7110                  LET K = K + 1
7115              GOTO 7100  'LOOP
7120 '
7125              GOTO 7160  'IFEND
7130 '            ELSE
7135              IF K > S(J,1) + L(J) - 1 THEN 7155      'LOOP
7140                  PRINT TAB(S9+K); "C";
7143                  LET H(K) = H(K) + R(J)
7145                  LET K = K + 1
7150              GOTO 7135  'LOOP
7155 '
7160 '            IFEND
7165              PRINT
7170        NEXT J
7175        PRINT
7180        PRINT
7185 RETURN
7190 '
7200 REM    SUBROUTINE:  PRINT RESOURCE HISTOGRAM
7202 REM      IN: H()
7204 REM    OUT: --
7205 '
7206 REM    PRINT OUT A HISTOGRAM THAT IS T9 TIME UNITS
7208 REM    ACROSS AND H9 UNITS HIGH.
7210 '
7211        FOR I = 1 TO H9
7212            FOR K = 1 TO T9
7213                LET G$(I,K) = " "
7214            NEXT K
7215        NEXT I
7216 '
7218 REM    FIND MAXIMUM, M, OF THE HISTOGRAM STEPS, H(K).
7220        LET M = H(1)
7225        FOR K = 2 TO T9
7230            IF H(K) > H9 THEN 7235 ELSE 7240
7235              LET M = H(K)
7240 '          IFEND
7245        NEXT K
7247 '
7250 REM    SCALE HISTOGRAM IF MAXIMUM IS LARGER THAN H9.
7251        LET A = 1
```

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CIRCLE 230 ON READER SERVICE CARD

CPM II, continued...

```
7252        IF M > H9 THEN 7253 ELSE 7254
7253          LET A = M/H9
7254 '      IFEND
7255 REM    MARK OUTPUT GRAPH G$(), WITH ASTERISKS.
7258        FOR K = 1 TO T9
7260            FOR I = 1 TO H9
7265                IF I*A <= H(K) THEN 7270 ELSE 7275
7270                  LET G$(I,K) = "*"
7275 '              IFEND
7280            NEXT I
7283 '
7285        NEXT K
7287 '
7288 REM    PRINT OUT THE ACTUAL HISTOGRAM ON THE GRAPH, G$()
7290        PRINT "RESOURCE USED"
7295        FOR I = H9 TO 1 STEP -1
7300            PRINT TAB(S9); "I";
7305            FOR K = 1 TO T9
7310                PRINT TAB(S9+K); G$(I,K);
7315            NEXT K
7317            PRINT
7320        NEXT I
7325        PRINT TAB(S9); "+----------+----------+";
7326        PRINT "----------+----------+"
7330        PRINT "EACH ASTERISK IS "; A; " UNITS OF RESOURCE."
7335        PRINT
7340 '
7345 RETURN
7350 '
7355 '
8000 REM    SUBROUTINE:  PRINT TABLE OF VALUES
8005 REM      IN: C, J$(), L(), N, S()
8010 REM    OUT: --
8015 '
8020 '
8025        PRINT "TIME OF COMPLETION = " ; C
8030        PRINT
8035        PRINT "JOB    LENGTH OF JOB    RESOURCE USED";
8036        PRINT "      START      SLACK"
8040        PRINT
8045        FOR J = 2 TO N - 1
8050            PRINT J$(J); TAB(15);L(J); TAB(30); R(J);
8052            PRINT TAB(47); S(J,1); TAB(58); S(J,2) - S(J,1)
8055        NEXT J
8060 '
8065 RETURN
8070 '
8075 '
8080        END
```

The second critical-path program works very much like the first program in its various subroutines. It does differ, however, in some ways from the first program. The most obvious difference is that a resource is associated with each job. This addition leads to a little new programming logic. The program still figures out the Gantt chart as before. But now, after the chart is drawn, the program adds down the page in each time unit to see what the total resource being used at a given time is. The results of this calculation are graphed in the resource histogram, sometimes called a resource density chart, which appears right below the Gantt chart.

The second way this program differs from its predecessor is that the user enters the starting times. Starting times must be under the user's control if he or she is to be able to delay select projects to make the resource histogram stay within bounds. The portion of the program that computed starting times in CPM-I has been converted to checking starting times in CPM-II. The program checks starts now because a user can make a mistake and start a new job before its predecessors have finished.

Exercises

1. Modify your project from CPM-I to include both a resource and a starting time for each job. Try it with CPM-II.
2. Sometimes it is interesting to see how the resources accumulate as the project proceeds. Write an additional subroutine to print the cummulative resource used. Try to make the graph square—from 0 to 100 percent of the resource on the vertical axis. □

Seeing NCC

Will Fastie

It's NCC time again.

Right about now, many journalists and their editors will begin the annual ritual of complaining about the National Computer Conference. This ritual is a long one, beginning just before the show and lasting several months, giving everyone enough time to get into print.

The complaints? The show is too big. The original purpose of the gathering has been lost; the exhibits overwhelm. The show is too big to fit in any one place. How about a return to the past—an East and West show? The show is too expensive for the exhibitors for what they get out of it. The show belongs to the bigger exhibitors. And so on.

Each of the complaints has a following, and substantial evidence to support it. I'm not too concerned with these kinds of issues, though. It's more important to decide if the NCC is of value, and if so, how to tap it for your own purposes.

A Personal Perspective

In my opinion, the show (exhibit area) has enormous value and the conference has little. For the past five years, I have sent a representative from my department to the conference and attended the exhibits personally. The unanimous opinion of the conference attendees has been that the time was not well spent. (We have gotten considerably more value from specialized technical conferences.) We have returned the NCC Proceedings to our Technical Library, where they are seldom read.

On the other hand, we have usually gotten our money's worth from the show. The opportunity to speak with suppliers whom we have not met, the chance to see new products "in the flesh," and the ability to do these things many times in the space of one or two days has convinced me that the NCC plays an important role.

Curiously, we usually do not learn of new products at the show. As a development group, charged with the responsibility of keeping our knowledge current, we typically learn of most "new" products well in advance of the show. If anything, the NCC lets us see, touch, and feel the things—it's a reality test.

There are surprises, though, and things to learn. I've found most of these in the small booths, off the beaten path. Last year they were in the basement. The year before, they were at the Disneyland Hotel, at the Personal Computing exhibits. They are not likely to catch your eye, and they might even be hard to find. But do find them. They're where the action is.

If you haven't made arrangements for the trip, it's too late.

Deciding To Go

There are usually two people involved in determining whether you attend the NCC: you and your boss.

If your company is going to send you to the NCC, they should get a reasonable return on their investment. Sure, you'll get a chance to fool around and eat a couple of great meals, but it's so easy to bring the value back that there is really no excuse for an empty trip report. What you must do is consider in advance, before you set foot on the plane, what it is you want to learn. What is the mission? Think it out carefully, take notes, and prepare to justify.

If you are the boss, deciding who and how many to send is the problem. Some of the decisions are pre-ordained if the trip is part of a reward system. The rest should be based on protecting your investment, on accomplishing something of value to your company.

Making the Arrangements

If you haven't made arrangements for the trip, it's too late. Oh you can stand in line to register for the NCC all right, but you'll have to sleep at Biff's Deluxe Motel & All Night Taxi Stand—it'll be the only thing left. The time to make your plans is in June, right after you get back from this one.

By January next year you should have your plastics from AFIPS, your hotel form in the mail, your plane reservations, and your itinerary cast in concrete. Then you can breeze past the lines, see the exhibits, attend the conference, and relax in a nice hotel each night.

If you are dying to try a particular restaurant, don't wait until you get there to make the reservation. Call a week or two in advance. There will be between 10 and 15 thousand people competing for those reservations each day of the show.

If you can avoid renting a car, do so. However, don't count on the NCC shuttle bus service. Plan on using taxicabs. Cabs are usually a good deal if you grab two other people to ride with you and split the fare. If you must rent a car, give someone else a ride.

Seeing the Show

Once you are there and ready to work, accomplish your mission first. This show is *big*, and if you've never been before,

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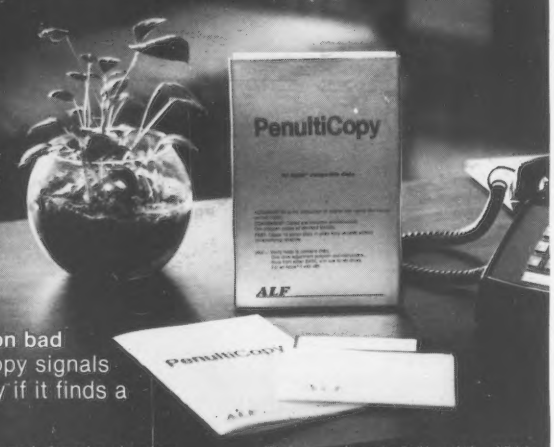

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NCC, continued...

you'll be surprised to find out how long it takes to see.

It can't be done effectively in one day. In order to do that, you must not speak to anyone and you must not stop walking. Don't even think about using the restrooms. And for heaven's sake, don't pick up any literature.

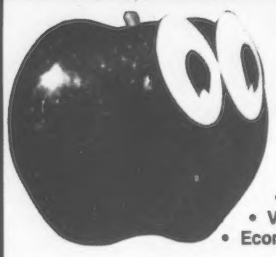
On the other hand, if you have two days, you may do all of the above, although you should avoid getting too interested in any one thing. Three days is fat city—you can even dawdle at a few booths.

Finally, the literature. If there is a brochure you can't live without, or something your boss has to see the second you get back, pick it up. Otherwise, hand the boothperson your badge and have the information sent to you.

If you do pick up anything, a bag is a must. The Datamation ones are the best. They are paper and must be cared for, but the handles are nicer and won't cut your hand to shreds. Take a handkerchief to wrap around them, just in case.

Think I'm kidding? Well, how much do 75 1/2-ounce brochures weigh? At 5:00 p.m., the answer is 50 pounds. And pick up the NCC Proceedings late in the day, so you don't have to carry it around. It weighs at least 50 pounds all by itself! Best hint of all: take a bigger suitcase than you need, so you'll have room for all your junk on the return trip.

See you there. Good luck! □



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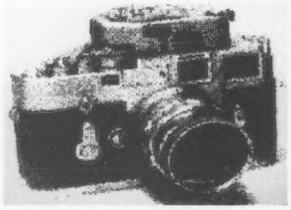

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Prime Time

Donald T. Piele

Of all the problems that have been posed in this column since it began back in September of 1980, none has generated more reader interest than the super fast prime generating program that appeared in December, 1981. I have received letters from doctors, lawyers, teachers, students, and hobbyists. The letters carried postmarks from all over the United States and a few foreign countries. I feel fortunate to be the recipient of this mail, because I can always count on picking up a new idea or two for looking at a problem in a slightly different way.

Generating prime numbers is probably one of the most familiar problems around. In 1959 when I first encountered this problem in a college computer course, the programming had to be done in machine language on the IBM 650.

As I recall, it was very tedious. The program had to be entered via punched cards, and completing a session was slow work.

There was little concern at that time about the efficiency of the program. We just hoped the thing would run.

The students in the class were well prepared mathematically, but when it came to communicating with the computer, we were all just beginners. It was an interesting experience, but much too frustrating and laborious to be taken seriously. All but the most patient among us returned to the comfort of our respective disciplines confident that someone who hadn't worked with the computer hadn't missed much. That was in 1958.

Today the picture has changed completely. A prime generating programming problem is one a good junior high school student can write in Basic. In fact it is becoming increasingly easy to assign programming problems that examine a wide variety of mathematical concepts to younger and younger students. The following discussion is designed to be understandable to a rank beginner.

Prime Factorization

Factoring a number into its unique product of prime numbers is something every school child learns how to do by the seventh grade:

$21 = 7 \times 3$

$100 = 5 \times 5 \times 2 \times 2.$

What Basic programming skills are necessary to program a computer to automate this process?

1. How to input a number into a program.

INPUT N

2. How to use the integer value function (INT(X)) to check for divisibility of one integer by another. Recall INT (X) equals the largest integer less than or equal to X.

INT(2) = 2, INT(2.5) = 2, INT(2.9) = 2, INT(3) = 3.

Thus, we can check whether a factor F divides evenly into an integer N by comparing the quotient N/F with INT(N/F).

IF N/F = INT(N/F) THEN (F is a factor of N).

3. How to generate a sequence of numbers 2, 3, 5, 7, 9, 11 . . . to serve as possible factors.

```
1  F = 1
2  F = F + 1
3  IF F > 3 THEN F = F + 1
4  GOTO 2
```

4. How to print out a factor and replace the original number with the quotient.

```
PRINT F,
N = N/F
```

5. How to test when there are no factors remaining.

IF N = 1 THEN done.

Putting these skills together, we have the following bare bones program for prime factorization:

```
10 PRINT "PRIME FACTORIZATION"
20 REM
30 INPUT "Enter a positive integer ";N
40 F = 1
50 F = F + 1
60 IF F > 3 THEN F = F + 1
70 REM
80 IF N/F <> INT(N/F) THEN 50
90   PRINT F;
100     N=N/F
110     IF N = 1 THEN PRINT : END
120 PRINT "x";
130  GOTO 40
```

Run this program with numbers such as 100, 195, and 1001, where all the prime factors are relatively small

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(1001 = 7×11×13), and this program is fast. Try a number like 1234567 and see what happens. It takes three minutes on an Apple II to find the prime factorization: 1234567 = 127×9721.

Albert Nijenhuis, a reader from Philadelphia, saw this program in the January 1982 issue of *Creative Computing* (page 161) and suggested a one line addition which cut the time for the above factorization to three seconds—a speed-up factor of 60. This idea is often found in prime factorization programs and is based upon a simple mathematical observation: If N is not prime, then it can be factored, N = F×G, and one of the factors F or G must be less than or equal to the square root of N. (If both F and G are greater than the square root of N then F×G would be greater than N, a contradiction.)

How is this fact used to cut the speed of this program drastically? Simply stop looking for prime factors of N once the candidates F are larger than the square root of N. This is done by adding line

70 IF F*F > N THEN F = N: GOTO 90

Improving the speed of a computer program requires the same type of insight that we often associate with problem solving in mathematics. As a skill, it is difficult to teach; the best way I know is to study lots of examples. Let's continue.

Generating Prime Numbers

I learned two facts about the problem of writing a fast Basic program to generate the prime numbers between 2 and 1000: everyone has a favorite program, and every program can be improved.

One way to generate the prime numbers between 2 and 1000 would be to check every odd number between 3 and 999 for its prime factors using the program listed above and to print out those that had only one factor, themselves. This will do the job, but it is very slow—especially toward the end of the list. A much faster procedure uses the Sieve of Eratosthenes [1].

To see how the sieve produces the primes from 2 to 999, begin with the top row in Table 1. This row contains all of the integers from 2 to 1000. Each succeeding row results from crossing out numbers from the row above it according to the following rule:

Start from the left and circle the first non-circled number. Now cross out all multiples of the circled number.

The bottom line is the set of prime numbers.

Row	
1:	2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
2:	(2) 3 × 5 × 7 × 9 × 11 × 13 × 15 × 17
3:	(2) (3) × 5 × 7 × × × 11 × 13 × × × 17
12:	(2) (3) × (5) × (7) × × × (11) × (13) × × × (17)

Table 1. Sieve of Eratosthenes

What Basic programming skills are needed to program a computer to automate this process?

1. How to initialize an array.

```
DIM X(1000)
FOR I = 2 TO 1000
  X(I) = 1
NEXT I
```

2. How to delete multiples of P.

```
FOR I = 2*P TO 1000 STEP P
  X(I) = 0
NEXT I
```

3. How to find the next available prime.

```
FOR J = P+1 TO 1000
  IF X(J)>0 THEN P = J : (go to step 2.)
NEXT I
```

Putting these skills together, we have in Listing 1, the standard sieve program for finding the primes between 2 and 1000.

Listing 1.

```
 10 PRINT "SIEVE OF ERATOSTHENES - STANDARD"
 20 REM
 30     DIM X(1000)
 40     FOR I=1 TO 1000
 50       X(I)=1
 60     NEXT I
 70 :
 80     P=2
 90     PRINT P;
100 :
110     IF 2*P>1000 THEN 160
120       FOR I=2*P TO 1000 STEP P
130         X(I)=0
140       NEXT I
150 :
160     FOR J=P+1 TO 1000
170         IF X(J)>0 THEN P=J : GOTO 90
180     NEXT J
190 END
```

This program takes 25 seconds to generate the primes between 2 and 1000 on an Apple II. How much time can be saved by using insight?

First let's look at the mathematics:

1. In the sieve algorithm it was indicated that, once a number is circled, its multiples are to be deleted. But in reality, many of those multiples have already been deleted; the first multiple of P that has not been deleted already is P*P. Test it out with paper and pencil.

2. Stepping by P in line 120 is also a duplication of effort, since it stops at P*P+P = P (P+1), which is an even number (odd×even = even). The same is true for 3*P, 5*P and so forth. Thus it is to our advantage to step by 2*P.

To implement these two ideas, change lines 110 and 120 as follows:

110 IF P*P > 1000 THEN 160
120 FOR I = P*P TO 1000 STEP 2*P

3. Finally, since 2 is the only even prime, we can eliminate the even numbers in the initialization phase, line 40.

40 FOR I = 1 to 999 STEP 2

With these modifications, the time for this program on the Apple II drops to 16 seconds.

To make a quantum leap in time savings we need a real breakthrough. If we reverse the way we keep track of the numbers in the sieve, we can skip the initialization process (lines 40-60). In most systems, an array is automatically initialized with zeros once it is dimensioned—Atari is the exception. Thus, if we let the 0 in the array X(I) mean that I is prime and design the algorithm to place a 1 in the location X(I) when I is not prime, we can eliminate the time for initialization.

Other factors help in little ways:

1. Use of an integer valued array X%(1000).

2. Use of IF X%(P) THEN . . . in place of IF X% (P) = 1 THEN . . .

3. Use of STEP P + P in place of STEP 2*P.

4. Slight rearrangement of the branching in the program.

Putting these suggestions all together in one program results in the truly super-fast algorithm shown in Listing 2.

Listing 2.

```
 10 REM Sieve of Eratosthenes - Super Fast
 20 DIM X%(1000)
 30   PRINT "2";
 40   FOR P=3 TO 31 STEP 2
 50     IF X%(P) THEN NEXT
 60   PRINT P;
 70     FOR J=P*P TO 997 STEP P+P
 80       X%(J)=1
 90     NEXT
100   NEXT
110   FOR P=33 TO 997 STEP 2
120     IF X%(P) THEN NEXT
130     PRINT P;
140   NEXT
150 END
```

Any program can be speeded up by deleting the REMs and putting multiple statements on one line. When this is done with the program in Listing 2, the time of execution on the Apple

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By Fred Huntington

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drops to an incredibly low six seconds. Is this the best one can do?

I thought it was until I received a letter from Donald Malm, a professor of Mathematics at Oakland University in Rochester, MI. Unlike the majority of the programs I received, which were slight variations of the program in Listing 1, Dr. Malm's approach was quite different and had the definite stamp of a mathematician. Before commenting on his approach let's take a look at a cleaned up version of his program. See Listing 3.

Listing 3.

```
 10 REM Sieve of Eratosthenes - Even Faster
 20 DIM N$(1000)
 30   PRINT 2;
 40   FOR P=3 TO 31 STEP 2
 50     IF N$(P)="1" THEN NEXT
 60     FOR J=P*P TO 31*(P-3) + 997*(P>3) STEP P+P
 70       N$(J)="1"
 80     NEXT
 90     PRINT P;
100   NEXT
110   FOR P=37 TO 997 STEP 6
120     IF N$(P-2)<>"1" THEN PRINT P-2;
130     IF   N$(P)<>"1" THEN PRINT P;
140   NEXT
150 END
```

With the remark statement and all unnecessary spaces taken out, this program takes about 5.3 seconds to run on the Apple. How does it do it? It substitutes cunning for brute force and cheats a little bit in the process. Here is how it works.

This program gains all of its time in lines 110-140 where it steps by 6 instead of 2. Since P starts at 37 (which is equal to 1 MOD 6), P will always be equal to 1 MOD 6 and P-2 will always be equal to 5 MOD 6. As a result, all multiples of 2 and all multiples of 3 are skipped in the sieve. This can be seen in Table 2.

	Column				
a	b	c	d	e	f
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18
19	20	21	22	23	24
25	26	27	28	29	30
..	..	..	..	..	..

Table 2.

Notice that columns b, c, d, and f contain all the numbers that are multiples of 2 or 3. If we can skip over these numbers, we can significantly reduce the amount of checking that must be done in the sieve. The remaining rows, a and e, contain the numbers congruent to 1 MOD 6 and 5 MOD 6, respectively.

The trouble with this program is that it gains valuable tenths of a second by knowing ahead of time that 3 is a prime. Under the rules of challenge [2], one could only know ahead of time that 2 is a prime. One has to stop somewhere or else the problem quickly generates into a triviality: compute all the primes ahead of time and print them out in one print statement.

So, where does that leave us? Under the conditions of the problem, The Super Fast program listed above is still the fastest. But the experience from this problem proves, once again, that any program can be improved.

Know Thy System

People who know their systems well took one look at the times reported in the December 1981 article and suggested ways to improve them, for their particular system, without changing the algorithm at all. Lane Lester suggested the following: "For the most favorable comparison of the speed of the Radio Shack Color Computer with other machines it is necessary to POKE 65495,0 before running the test. This sets the microprocessor to a higher speed than the one that is initialized when the unit is first turned on." I tried this and it did speed up the time from 10 to 6.3 seconds.

Walter Lee was able to take 3 seconds off the time reported for the Atari by turning off the display processor, Antic: "The display processor steals time from the 6502. By turning it off, we can increase the execution speed. The operating system eats up time during the vertical blank interrupts, so by poking 1 into the CRITIC flag (location = 66 decimal), we can shorten the vertical blank interrupt but still operate the real-time clock (location = 20,19). The CRITIC flag is disabled by POKE 66,0 and the screen immediately reappears with all the prime numbers." (See Listing 4.)

Listing 4.

```
0 GRAPHICS 0:POKE 66,1:POKE 19,0:POKE 20,0 : DIM
  N(1000):?2;
1 FOR P=3 TO 997 STEP 2:IF N(P) THEN 4
2 IF P<32 THEN FOR Y=P*P TO 997 STEP 2*P:N(Y)=1:NEXT Y
3 ?P;
4 NEXT P:?:?(PEEK(19)*256 +PEEK(20))/60:POKE 66,0
```

Primes Larger Than 1000

Donald Tucker submitted an interesting extension of the sieve program to print out the primes between any two limits no more than 10,000 apart with an upper limit not to exceed 100,000,000. His program was written for the Atari. Listing 5 is an Apple version for primes no more than 8,000 apart.

Listing 5.

```
  1 REM LARGE PRIME PROGRAM
 10 REM By Donald Tucker
 20 REM Primes between lower limit F and upper limit L.
 30 DIM A%(8000),G%(8000)
 40 INPUT "ENTER LIMITS F,L ";F,L: T3=SQR(L):T4=SQR(T3)
 50 IF F=2*INT(F/2) THEN F=F+1

 60 REM Begin loop
 70 FOR T=3 TO T3 STEP 2:IF A%(T) THEN NEXT : GOTO 170
 80 IF T>T4 THEN GOTO 100
 90 FOR V=T*T TO T3 STEP T+T: A%(V)=1: NEXT V

100 REM Eliminate the odd multiples of the factor T
110 H=INT(F/T)+1
120 IF H=2*INT(H/2) THEN H=H+1
130 IF H<T THEN H=T
140 IF H*T<=L THEN FOR V=H*T TO L STEP T+T:X=V-F
150 G%(X)=1:NEXT V
160 NEXT T
170 REM Print Results
180 FOR V=F TO L STEP 2: X=V-F: IF G%(X)=0 THEN PRINT V;
190 NEXT V
200 END
```

Acknowledgements

I would like to thank the many people who contributed programs and comments. Jim Michalets, a student from Greendale High School in Greendale, WI, was the first to send in a version of the fastest algorithm. Others with interesting versions were: Delmar Hinrichs from Washougal, WA; David Neal of New Castle, CO; Albert Nijenhuis of Philadelphia, PA, who also sent in some very nice programs for generating Lucky Numbers; Harley Dyk of Grand Haven, MI; Bruce Blodgett from East Lansing, MI; and K. Rodenhuis from The Netherlands. □

References

[1] Piele, D.T. "The Second Annual International Computer Problem Solving Contest," *Creative Computing*, 8:1, p. 154-163, January, 1982.

[2] Piele, D.T. "Mathematical Sieves, " *Creative Computing*, 7:12, p. 286-297, December, 1981.

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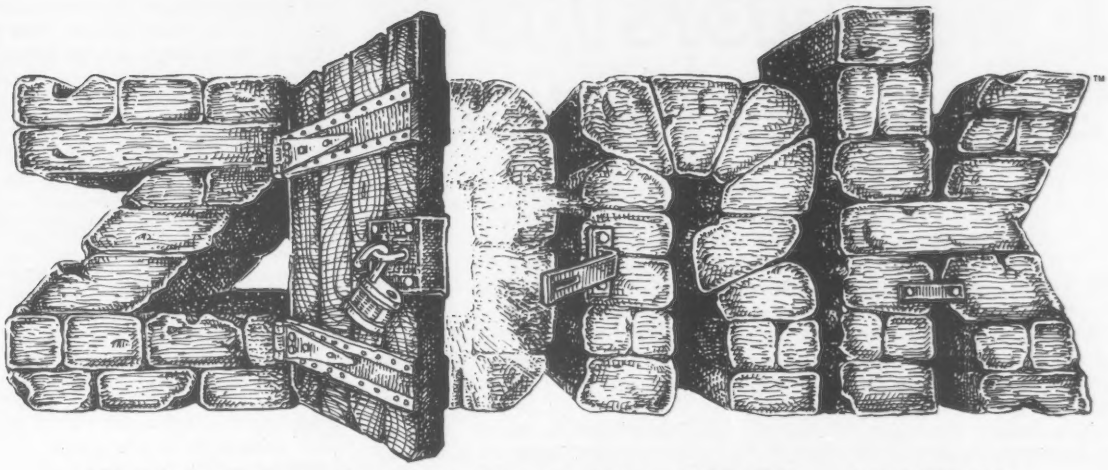

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We want to buy a personal computer and we want it for business reasons and personal reasons. We are willing to spend money even to the point of going into hock for a few thousand dollars. But we haven't purchased one yet because no one has sat down with us and explained the benefits and taught us how to get hands-on experience with a unit.

Here's what happened on the mystery shopping trip.

Computer store number one is in a relatively high rent district. There is a good amount of rental space in the store, and it is stocked full of sales people—or should we say people on the payroll.

The store carries a full line of merchandise from the low-end video game type computers to the more sophisticated and more expensive equipment.

We went into the store in the afternoon, after lunch, when only a few customers were present. We walked around the shop once just looking. No one approached us. We stood around maybe 10 minutes. No one approached us. Finally we asked someone if he worked there.

"Yea I work here," he replied, not looking up from his reading.

"I'd like to look at one of your computers," we said.

"Which one," he asked, finally looking up.

"I don't know," we confessed. "I'd like a unit I can use in my business and one from which I can derive some personal enjoyment."

The employee said to wait a minute. He walked over to another employee who was busily playing with a computer. The person working the computer was visibly annoyed to be bothered. Our man returned and said that he would help us. What did we want?

We explained we were in the writing business and wondered whether or not it was possible to have a computer from his vast selection which would have some word processing capabilities, some accounting capabilities, and which, during off hours, could play blackjack or chess.

Maybe we'll wait to buy a personal computer. Maybe we'll wait until some of the big audio or video specialists get into the business who know what a customer looks like and how to treat him.

Our man disappeared for about five minutes and returned with a floppy disc.

"This enables you to have word processing capabilities," he said, and placed it in a drive mechanism.

He typed a few words, but his full attention wasn't on the demonstration.

"How do you correct misspellings," we asked. He showed us.

"Can you insert or delete full paragraphs," we asked. He said to wait a minute and he disappeared into the back. We played with the computer for a while. The screen filled up with words. We began pushing keys to try and erase what we had typed. We couldn't. We looked around for our man. We couldn't find him. We waited 15 minutes for him to return. He did not come back. We left. We won't return there ever.

A second computer shop was smaller. Here we were more specific what we wanted. We'd like a several thousand dollar computer but we need a really good printer, we told the man. We discovered it would cost about $3,000 for such a printer. That is kind of expensive, we said, but maybe we could swing it. Could we have a demonstration?

"No," replied the employee, "the machine is on the road."

"When will it be back in the store?"

"Can't say," he replied. "Why don't you give us a call in a week or so."

"Sure buddy," we thought to ourselves. "But don't hold your breath."

Then there was the third computer store. We'd seen this one written up in trade journals. It must be good . . . We again entered the store in the afternoon when it was not busy.

There was a youngish looking man sitting in front of a computer with another man. They pushed keys, things came on the screen which they cursed. They pushed more keys, more things came on the screen, more curses.

We walked around and looked at some of the computers which were featured. One was on special. We turned it on but there was no power. We looked at another which also was not plugged in. We waited. This time 20 minutes passed.

Finally a second man came into the store and one of the employees on the computer finally took notice. He got up and walked over to the latest arrival. This man was obviously a salesman and nervously said to the employee that we were there ahead of him. The employee finally took notice of us and came over to see what we wanted. We explained. He handed us some literature, and walked back to the newly arrived salesman.

We stood around and waited until they were finished talking. As the employee was walking back to his computer, we blocked his way and told him we'd like a demonstration.

"Can't do it now," he said, "I'm too busy. Why don't you drop in between 10 a.m. and 12 noon sometime. That's the slow time and I'll give you a demonstration."

Maybe we'll wait to buy a personal computer. Maybe we'll wait until some of the big audio and video specialists get into the business who know what a customer looks like and how to treat him.□

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Osmo A. Wiio

I Don't Understand a Word of It.

Have you ever had trouble understanding a microcomputer sales brochure, instruction manual, and other documentation? Join the club; I have had a lot of trouble.

For example, I needed more memory. So I ordered Bitbyte X16KR memory board. The price seemed fair and somebody recommended it for my S-100 system.

After a long wait the package finally arrived. I inspected the board and everything seemed to be in order. So I went to the manual to find out about addressing. I didn't understand a word. It looked like this: "The MSB's of the data sent out to the addressed port control the selection of the banks to receive the command. A logic zero in bit position 7 will direct the command to bank X, and a logic 0 in bit position 6 will direct the command to bank Y."

I did not have the slightest idea what or who the MSBs were, where banks X or Y were supposed to be (I use Bank Z) not to mention their addressed ports. I guess it helps to have an address on the port, though.

Bad Documentation

With some expert help I finally managed to get the DIP switches set correctly. The fact that I was never able to get the board to work properly is another story. This story is about the lack of communication between the hardware and software producers and their novice customers.

The producers still seem to be speaking to computer engineers when, perhaps, the majority of personal computer users today are nontechnical enthusiasts: computer amateurs like me.

I assume that I am not the first to complain about this. Certainly I will not be the last. This matter has bothered me in several ways. First, as a buyer and user of computer equipment. Then as a "professional in comprehension." I am a university professor of communication (behavior) and I did my doctoral work on readability.

And to me, most of the documentation in the field of personal computing is poor. There are a few exceptions, but very few. Documentation is, however, an integral part of a computer system. And documentation must be designed for the intended user, not for the producers themselves.

Osmo A. Wiio, Orisaarentie 4 K, 00840 Helsinki 84, Finland.

Most of the documentation in the field of personal computing is poor.

Elements of Comprehension

Readability studies and research into the human information process have shown that there are at least the following main factors of linguistic comprehension: language, level of abstraction, identification, and interest.

The first point deals with the *form* of the message and the others with the *content*. All the elements interact. It is seldom possible to blame only one of them or to improve difficult text by changing only the language form.

The message may reach the receiver in a communication situation. It may even be accepted by the receiver. However, it may not be understood or it may be understood in a different way from that intended by the sender.

Comprehension is a process in the receiver. However, the message and the communication situation also influence the information process of the receiver. Thus, the total understanding of the message is influenced by the communication situation, the message, and the receiver.

Human Information Processing

Detailed articles about human information processing have appeared in microcomputer magazines in the past. I must return to the subject, however, to make it easier to understand why we do or do not understand.

In a human, the brain, the nervous system, and the senses constitute the *control system*. This system controls our actions in a rather complex way. Energy changes from the environment activate the sensory system which transfers the input impulses in an electrochemical process into the *short term memory*, which, perhaps, is also our "consciousness."

The short term memory (STM) is a temporary working memory with a limited information handling capacity. According to psycholinguist George A. Miller it can process "seven plus and minus two words" simultaneously. A word here is to a human approximately the same as it is to a computer.

If the incoming signals are accepted, they can cause action in the body functions and/or be transferred to the *long term memory* (LTM). Electronic pulses induce permanent chemical changes in neural systems, and permanent (we hope) memory images are formed.

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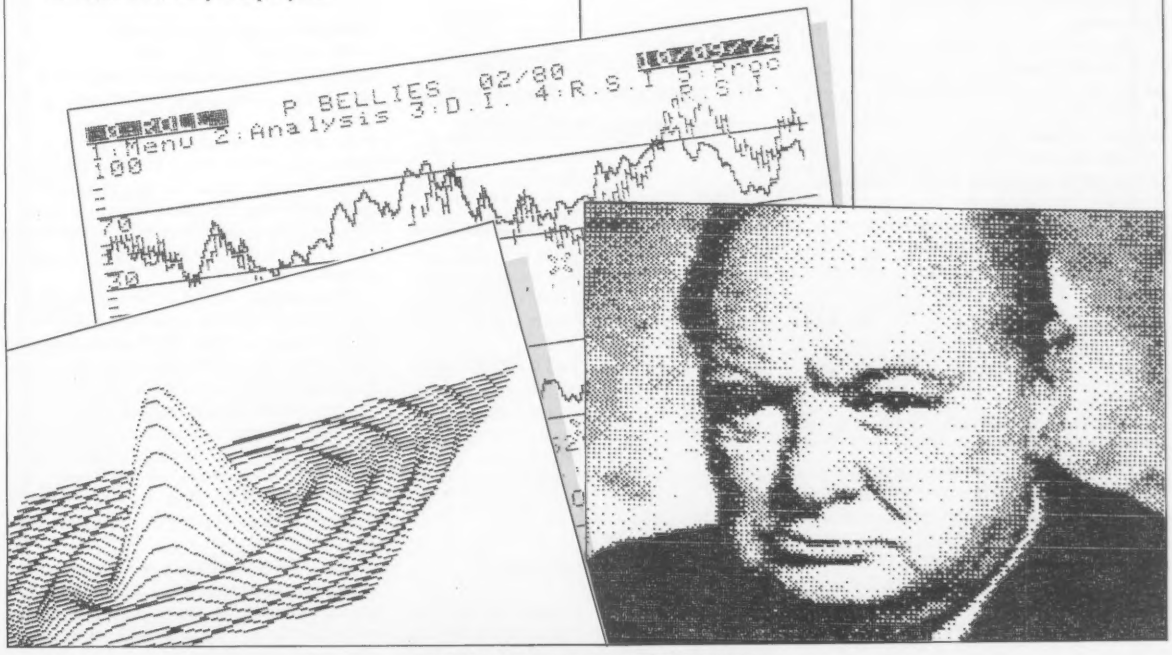

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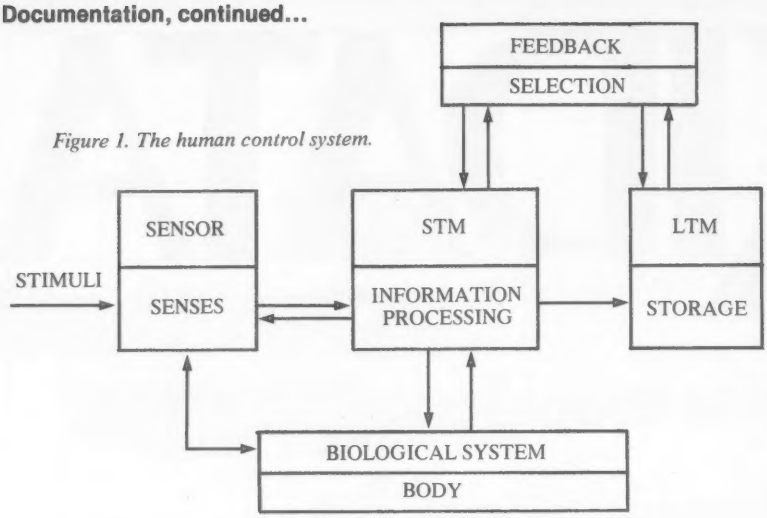

Figure 1. The human control system.

Memories in Brain and Computer

We might say that the STM is a very small and short term RAM while LTM is our main memory system: ROM, RAM and floppies. The functions of the STM can be compared with the CPU registers.

STM is very much like a small dynamic computer memory. It has to be constantly refreshed for the images to stay there and even then it cannot hold memories for more than a few seconds. Our long term memory is more like a static computer memory.

Understanding and Information Processing

The function of STM and LTM are essential for understanding language. Let us see how you would probably process the following sentence: Here we have a boy with a large, red ball.

There are ten words in the sentence. It seems likely that your STM divides the sentence in two parts. You read first: Here we have a boy. Then your short term memory stops to process that piece of information. STM seems to take in as many words as conveniently fit into this small storage—usually between five and ten words.

Now follows a discussion between your STM and LTM. Your "monitor system" (in ROM) seeks structure (syntax) in the message and also searches for meaning in the words (semantics).

The result of the discussion is an image of a boy: you understood the message, you gave meaning to the signals received by your control system.

After being understood the first part of the sentence starts to fade into LTM and your STM is ready to take in the second part of the sentence: with a large, red ball.

You have no difficulty understanding this, and the image of a large and red ball is transferred to LTM.

Now suppose the sentence had been: Here we have a cluster with the relevant factory redundancy.

Your STM takes in "here we have a cluster" and tries to process that, then it tries to understand the meaning of this piece of information. Let us assume that you don't know what "cluster" means.

The more familiar the message, the better the understanding.

You are not able to form a meaningful thought of words. You just have an image: Here we have ?. Then you continue the rest of the sentence: with the relevant factor redundancy.

You may not know the word "redundancy" or "relevant" or what the combination of these words means. You are not able to construct a meaningful thought unit of the words. So the electric pulses circulating in your STM disappear without leaving any image in your LTM.

We Store Meanings, Not Words

It seems that we do not transfer the individual words of a sentence but the *meaning* of the sentence. STM has to construct a meaningful whole from the separate words. If this process is successful, then the meaningful whole (the meaning of the sentence) is transferred to LTM. Mind you, we don't transfer individual words but "meaningful chunks" to quote Miller.

Thus, it seems that when we process linguistic information (in our left brain half), we chop the strings of words into chunks of five to ten words. These chunks are processed and their *meanings* stored—not necessarily their words.

And if we misunderstand the meanings, then wrong meanings are stored. Spoken or written language has to be actively processed—understood.

Difficult, unfamiliar words contaminate the whole text. They make it impossible or very difficult for the STM to form the meaningful thought units (chunks) which are necessary for understanding.

Readability studies in different languages have shown that the *word factor*, selection of words, is the most important linguistic element of comprehension. The more unfamiliar and difficult words the text contains, the more difficult it is perceived to be.

Again we can compare the process with a computer. If you give a wrong command to the computer you get an error message or wrong performance. The wrong command is not understood or it is misunderstood. In your control system unfamiliar and difficult words are "wrong commands."

Difficult words are like wrong pieces in a puzzle: they make it impossible to assemble a meaningful whole.

Complexity and Understanding

We all know from experience that it can be difficult to understand long, complex sentences. Legal text is a very good example.

Complexity overloads the short term memory. If sentences are long and complex, the chopping action of the information process divides the sentence into too many chunks. The *information span* of the STM is too short to enable it to handle complex linguistic structures.

It seems that we can, somehow, manage two thought chunks simultaneously. One is processed in the STM while one is fading into the LTM. Thus, sentences up to about 18-20 words can be processed.

Comprehension decreases rapidly when the length of the sentence exceeds these 18-20 words. Also, the more complex the grammatical structure of the sentence, the more difficult it is for the limited capacity of the STM to process the structure.

Readability studies have shown that messages are perceived as difficult if they contain a large proportion of long, difficult and unfamiliar words and/or the sentences are long and complex.

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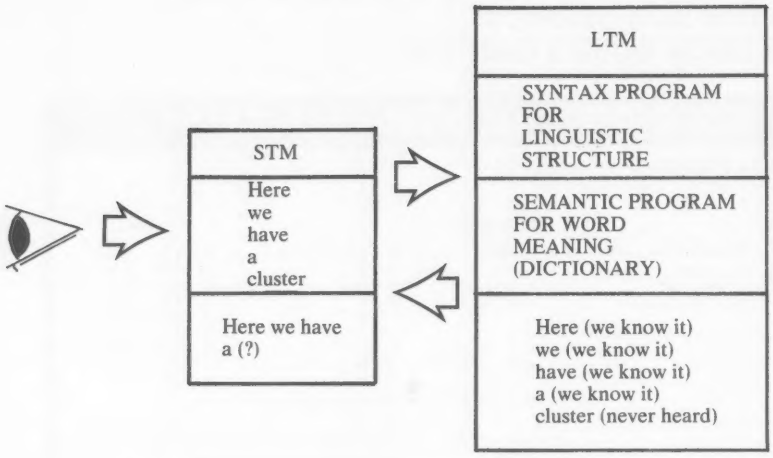
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Here we have a cluster
Here we have a (?)

Figure 2. Text processing in the human control system.

Level of Abstraction and Identification

Language structure is not the only element of comprehension. The *content* of the message is also important.

If you try to explain nuclear physics to a small child, he or she may not understand even if you use very easy language. The subject of the message is too difficult.

It is often said that it is easier for a rich person to become richer than for a poor person to become rich. If you already have money, it is relatively easy to generate more money. If you have very little money, it is difficult to start any activity which might generate new money.

It is the same with knowledge. The more you already know, the easier it is to learn more. I speak five languages and understand some five or six more. To me this is nothing extraordinary, because languages come in groups. If you know one foreign language the next comes much more easily.

The same principle applies to any information processing. The more you already know about a specific subject, the easier it is to understand new information about it.

The level of abstraction refers to the relationship between the message content and reality. Abstraction is measured in the *concrete-abstract* dimension. Concrete things you can see, touch, hear and smell: a dog, a house, a girl, money, etc. Abstract things are conceptual, such as freedom, religion, democracy, beauty, etc. Usually the more concrete the message, the easier it is to understand.

A frequent finding in communications research is that the more education a person has, the easier it is for him to understand abstract language.

This is not necessarily related to intelligence: apparently formal education trains us to process conceptual (abstract) information. This is a very important factor to consider in mass communication because there are usually many levels of education in the audience of the media.

The most famous of these formulas for English, the Reading Ease Formula, was developed by Rudolf Flesch during the 1940's and 1950's.

Identification, which is the ability to relate oneself to the subject matter is closely related to the level of abstraction: the more familiar the message, the better the understanding.

Thus, if you have to explain difficult technical material to non-experts, you should start with familiar, concrete things. Use them to introduce new things, and new concepts.

Interest

Strangely enough, interest in the message is a comprehension factor. The more interested you are in the subject matter, the more mental work you are willing to do to understand the message.

In mass communication, interest, however, has another crucial function. It determines whether the receiver is willing to receive the message at all. I am sure that the editor of this magazine thinks about this all the time: do we reach the readers?

How To Measure Readability

How do you know whether a particular text is easy or difficult to comprehend?

Professionals in the media develop a "feel" for it. They can "smell" difficult language. If you don't have that sense, you can use something called a "readability formula." These are mathematical models based on statistical analyses of written material ranked for difficulty in experiments.

The most famous of these formulas for English, the Reading Ease Formula, was developed by Rudolf Flesch during the 1940's and 1950's.

There already exist several programs available to compute readability using microcomputers. (Programs to determine readability may be found in the following issues of *Creative Computing*: April 1980, March 1981 and April 1981.) The next step is to combine this computation with word processing programs. When you have written a document, you immediately obtain a readability quotient for your text.

What Makes Writing Difficult to Understand?

If we apply the principles we discussed here, we can make the following generalizations:

Difficult writing has the following characteristics:

- Many words which are longer than average, unfamiliar and specialized, often of Latin or Greek origin.
- Long, complex sentences—the average sentence length exceeds 18-20 words.
- Presentation based on abstract concepts with very little relation to "perceived reality."
- Subject matter strange and distant for the receiver.
- Subject matter not interesting to the receiver.

What Makes Writing Easy to Understand?

Avoiding the points listed above is likely to produce writing that is easy to understand. It will have the following characteristics:

- Many words which are short and familiar, mostly of Anglo-Saxon origin.
- Simply structured and relatively short sentences—the average sentence length is 10-20 words.
- Presentation based on concrete ideas which can be perceived by the receiver.
- Subject matter familiar—or approached through familiar concepts.
- Subject matter of interest to the receiver.

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Don't Understand, continued...

Almost all subject matters can be made easy to understand (just read a writer like Isaac Asimov). It also very seldom happens that clear writing turns away readers. The opposite is almost always true.

Examples

To illustrate my point I shall name a few concrete examples of difficult and easy to understand writing (as I perceive them) in the field of personal computing.

To start with the bad news, I found the Processor Technology (SOL) hardware documentation just about impossible to understand. It was written by engineers for other engineers.

If you are not a software expert you get very little out of the CP/M manuals. I have learned most of my CP/M from more knowledgeable friends and magazine articles. Even so I don't think I am able to use more than a fraction of its potential.

I think CP/M is a very good example of a first class product which is too specialized.

I don't think manufacturers realize how many personal computers have reached novice users.

Another example is Thinker Toys. I have several of their fine boards, but I always have trouble with their documentation. And the fault may not be completely mine.

I don't think manufacturers realize how many personal computers have reached novice users. They still write their specs for fellow engineers.

Now the good news. I have found some excellent documentation in which most of the principles of "popularization" have been observed. It may not come as a great surprise that one of these is Heathkit. They have a long tradition of making difficult technical material easy to understand. Their courses "Basic Programming" and "Assembly Language Programming" should be used as models by writers of documentation.

I may not be the only one who thinks that a large part of the success of the TRS-80 systems is due to the fine documentation produced by Radio Shack.

Let me conclude by saying that I don't have anything against experts using expert language when they speak to each other. But when experts speak to non-experts using expert language, the communication process is abused. □

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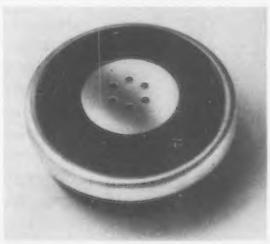

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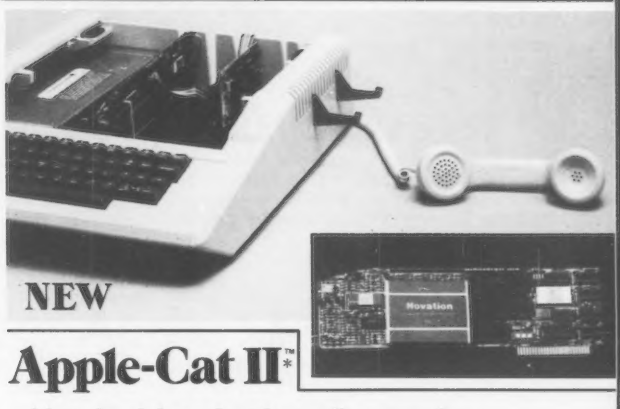

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CIRCLE 206 ON READER SERVICE CARD

Machine Intelligence: A Function of Human Ingenuity

Christos J. Georgiou

In the late 50's, linear programming was very much in vogue. Linear programming does not mean programming in a straight line, but rather is an exhaustive approach to solving large sets of simultaneous equations ultimately to reach a perfect solution to a problem. Unfortunately the method took vast amounts of computer time. For example, to schedule a railroad train of mixed loads for the most efficient route took upwards of 100 hours of computer time—not very practical considering that scores of trains leave hundreds of yards every day.

"But wait," said the computer scientists. When the computers get bigger and faster, they'll be able to solve these problems.

Lost amid the legions of linear programming advocates was a small group of people at Carnegie-Mellon University led by Drs. Alfred Kuehn and Tim McGuire. These people, and others, pursued the notion of a heuristic approach. In other words, start with some rule of thumb and then try shifting things around to approach a better solution. This doesn't necessarily reach the best or perfect solution, but rather an acceptable one from the standpoint of solving the problem in a reasonable amount of time.

Now, some 20 years later, people are "discovering" that these principles apply to small computers too. Surprise! That, in no way, is meant as a put-down of this article. Quite the contrary. The lessons one can learn from this article demonstrate in the author's words, "that the ultimate solution to a problem is more likely to be found in a combination of machine power and programmer resourcefulness than in machine 'brute force' alone." Bravo.

Not only that, but the Knight's Tour program will allow anyone with a Basic speaking computer to experiment with some facets of artificial intelligence.

— DHA

Programming computers to play board games such as chess or checkers, or to solve various puzzles can be an enjoyable but frustrating experience. The fun part comes when the computer, whether it is an IBM 370 located at some multi-million dollar data processing center or a personal computer on your desk at home, comes to life and starts to think.

Frustration can quickly dampen the initial excitement, though, when some time later the machine fails to see the correct move—a move that should have been obvious to even the average human player. Attempts to increase program intelligence by implementing deeper next move look-ahead or more sophisticated position evaluation routines, usually result in endless waiting for the machine to make its next move—again taking all the fun away. In intelligent computer games, therefore, the problem of machine intelligence vs. speed is the single most important consideration that must be dealt with.

In the first part of this article, the question of how to improve the intelligence of computers without paying a high price in program execution time is addressed. Then, an example is shown which attests to the fact that the ultimate solution to this problem is more likely to be found in a combination of machine power and programmer resourcefulness than in machine "brute force" alone.

Game Complexity and Machine Limitations

Game playing and puzzle solving by computers fall under the broader heading of artificial intelligence. The performance of artificial intelligence programs and algorithms is critical not only in terms of producing meaningful results but also in producing them quickly enough to satisfy time requirements imposed by humans. Programs that fail to do so are, for all practical purposes, useless. Unfortunately it turns out that, in most cases, the time of program execution increases proportionally to any increase in intelligence. Furthermore, this relationship is not linear but exponential.

Christos J. Georgiou, P.O. Box 388, Goleta, CA 93116.

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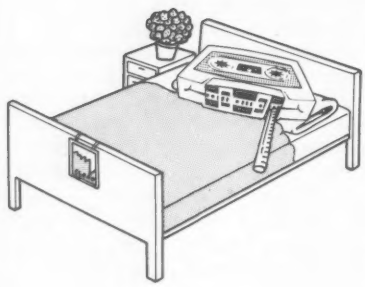

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Intelligence, continued...

This is due to the fact that artificial intelligence problems almost always involve tree-searches.

To demonstrate the dramatic increase in computational power required to obtain a relatively small increase in intelligence, let's look at an example: In the middle of a chess game it is estimated that a player can make an average of 50 legal moves from a given board position. If the chess program has only one level of next move look-ahead, then only 50 positions need be evaluated. As expected, the result of such shallow board examination will be very poor.

To make the program smarter, let's assume that two levels of look-ahead are implemented. This means that for each one of the 50 positions possible on the first move, another 50 positions must be evaluated. This amounts to 50*50=2500 positions. A third level of look-ahead will require 2,500*50=125,000 position evaluations, while a fourth will require 6,250,000. And, of course, if all the possible opponent responses from each position are examined,

The basic processor speed ratio between a personal computer and a multi-million dollar supercomputer is only about 1:100!

the number of evaluations becomes astronomical.

It has been shown in practice that the best chess programs are those with the most levels of next move look-ahead. It has also been shown that chess programs running in the world's fastest computer can afford only five or six levels of look-ahead for a real time 2 1/2 hour chess game. As a result, no chess program has yet achieved the distinction of being "unbeaten by humans." The question that may arise, then, is whether it may ever be possible to create the perfect machine that will beat any human challenger, and what specifications such a machine should have.

The first idea that comes to mind to improve computer performance is, of course, to increase speed. How fast, then, can computers run, and what is their absolute limit, if any?

Computer speed depends on both the basic processor speed (the time it takes to execute a simple instruction, such as transferring data from one register to another) and on its internal architectural

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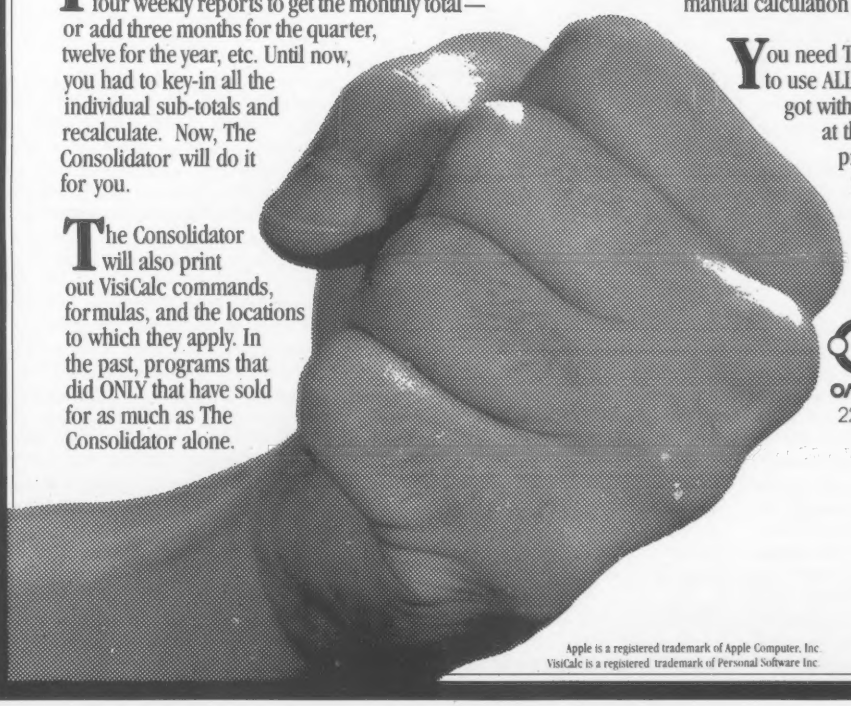

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features. To break it down even further, basic processor speed is a function of the technology used to make the processor components such as registers, ALU (Arithmetic Logic Unit), gates, memories, etc. Personal computers using n-MOS microprocessors (such as Z-80, 6502, etc.) can execute a register transfer in one or two microseconds. Large machines of the IBM 370, CDC 7600 or CRAY-1 type use faster basic components (bipolar TTL or ECL-Emitter Coupled Logic) and have speeds ranging from 10 to 100 nsecs for executing similar instructions. So the basic processor speed ratio between a personal computer and a multi-million dollar supercomputer is only about 1:100!

Computers that will operate in the sub-nanosecond region (using Josephson junction technology) are currently under development. In any case, even though the processor speed frontiers are being pushed back, there are physical limitations on the ultimate speed of a processor. The limiting factor is the speed of light (1 foot per nanosecond).

Hardware Improvements

If there are physical bounds to the basic processor speed, what else could be done to make programs run faster? To answer this question, let's think of the following: "Is a CRAY-1 just 100 times more powerful than a Z-80 based personal computer, and if so, why does it cost millions of dollars instead of just, say, $100,000?"

The answer is that the architectural features of the "large" machines, such as bigger and more powerful instruction sets, longer words, special hardware floating point units and other hardware features (such as "pipelines," cache memories, dual CPUs, etc.) that make the flow of instructions easier and faster through the machine, can significantly enhance their computational power.

Even with all this architectural innovation, however, chess programs have achieved only an "expert" rating. Have we reached the end of the computational capabilities of computers until solid-state researchers come up with the next generation of super-fast components? Well, not yet.

The advances in microelectronics have resulted in more and more powerful computers being put on silicon chips every day (Intel's 8086, Zilog's Z-8000, Motorola's MC68000). Since microcomputers have started approaching the capabilities of large computers, the potential exists to interconnect a large number of those (in the hundreds or even in the thousands) to form a multi-computer or multi-processor system. Then a program could be partitioned in smaller sub-programs (or processes) which would be distributed throughout this system, each one assigned to a single processor and each one running concurrently with every other one.

The introduction of parallelism in the execution of the program could produce additional savings in the overall program run-time and allow greater depth of position evaluation. The problems of efficiently interconnecting all these processors, the partitioning of the program in concurrently running processes and the synchronization of all these processors and processes is the subject of on-going research.

Finally, the game board itself could be represented by special hardware, instead of the more traditional representation by a data structure stored in the computer memory. That way, certain evaluations which would have been performed by the program could be carried out at the speed levels of the hardware gate, producing further time savings. The hardware board, for example, could automatically eliminate all illegal moves and moves that are obviously bad (allowing the king to be captured, etc.) significantly reducing the options that must be examined by the program, and, thus, playing the role of a hardware tree-pruner! (In fact, BELLE (designed at Bell Labs) the computer chess world champion which won the tournament at Linz, Austria in September 1980, uses such hardware. Even though the program runs on an inexpensive minicomputer, it was able to beat other programs running on more powerful computers.)

There is a class of problems for which no efficient algorithms may exist.

So, we have seen several ways of speeding up the game by improving the computer hardware. Is this approach going to accomplish the ultimate result, though? Again, we must consider the astronomical number of computations needed as we introduce more steps of next move look-ahead. (All permutations of a chess game from start to end can be as many as 10^{120}, a number that exceeds the number of atoms found in the universe.) It seems, therefore, that making the program run faster by using the "brute force" approach alone is not going to bring the desired results, even though speed improvements of many orders of magnitude could be achieved.

Software Improvements

A way of helping things out is to make the programs smarter and the algorithms more efficient, so that their computation time is reduced. First of all, the program must be written in a language that executes quickly in the machine. Interpreted languages such as Basic are very slow, since they usually require several milliseconds for the execution of a single statement. The best choice of language in terms of speed of execution is, without doubt, machine language that is executed directly by the hardware and can be tailored to the requirements of the problem. Machine language poses an additional problem in that it requires more time for program development and debugging than higher level languages. In spite of this drawback, however, almost all championship caliber chess programs have been written in machine language for the sake of speed.

Second, all searches for the best move must be carefully evaluated before being carried too deeply. Tree-pruning techniques (alpha-beta searching, etc.), if applied properly, can improve program run-time by many orders of magnitude. The basic idea behind tree-pruning is that, if you know a certain path will lead to a dead-end, there is no point in following it. A problem that may arise in its application, however, is the choice of criteria upon which the decision "to take or not to take" a path will be based. It is quite possible that a truly innovative move, such as sacrificing a queen and a rook to checkmate five moves later, may be bypassed by a tree-pruning algorithm.

Third, efficient algorithms must be devised and implemented. "Efficient" are those algorithms which can be executed in "polynomial" time, as opposed to inefficient" algorithms which usually need "exponential" time to execute.

For example, if the size of a problem is tripled, a polynomial time algorithm may require three times as much time (linear time algorithm) or nine times as much time (quadratic time algorithm), etc. In contrast, the next move generation example mentioned earlier uses an exponential time algorithm.

Efficient algorithms may represent the optimum in software design, however, it is sometimes very difficult to design them for certain problems. Theoreticians in computer science have come to the conclusion that there is a class of problems for which no efficient algorithms may exist, although no formal proof to the contrary has been produced. (An excellent discussion on the complexity of algorithms and intractable problems can be found in Ref. 3.)

And fourth, heuristic methods may be used when no rigorous algorithms can be found. Heuristics encompass all those trial methods that, even though they have not been proven mathematically and don't always work, can reduce the size of a big computational problem to a manageable size.

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CIRCLE 244 ON READER SERVICE CARD

Is This Enough?

What we have seen so far, is that innovation in machine hardware design along with the use of software speed-up techniques could bring computers closer to the ultimate goal in machine game playing and introduce better tools for the development of artificial intelligence.

How close can we expect to get to the perfect machine? Will the existing gap between a computer being rated chess expert and being rated world champion be easily bridged? Unfortunately, in solving an "exponential" difficulty problem such as this, small steps forward require tremendous amounts of effort. This has been the case with computer chess ever since compuers became available in the early 50's. A breakthrough in this area could happen any moment or could take years or even decades to occur.

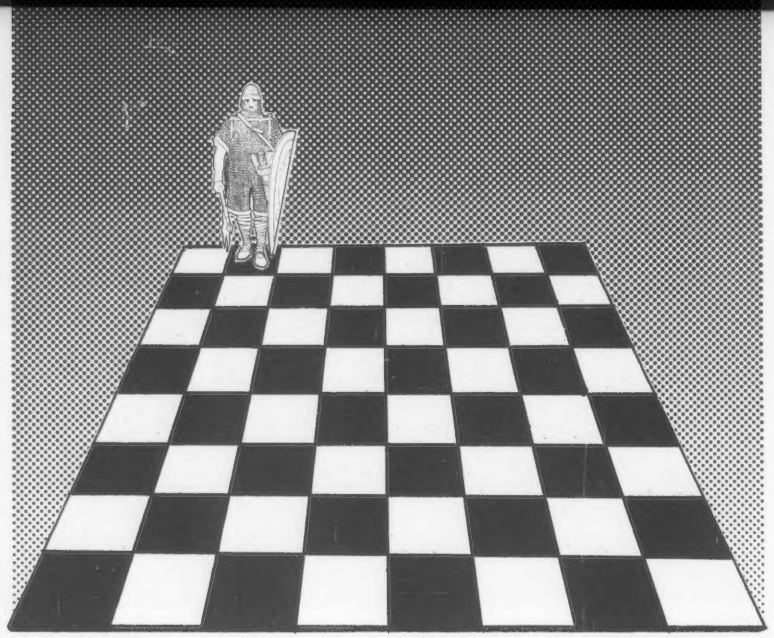
What cannot be ignored is the contrast between the capabilities of the human brain, which seem so limited in terms of performing repetitive operations (how many floating point multiplications can a person do per second?), but are so immense and unchallenged where creativity, recognition and imagination are concerned. This leads to the conclusion that the answer is more likely to be found through a combination of human ingenuity and computer versatility than through unbounded machine power alone.

How close can we expect to get to the perfect machine?

An example which demonstrates the difficulty of devising efficient algorithms for certain problems and also shows the fantastic savings in computation time if the right algorithm is used, is an algorithm that solves the century old "Knight's Tour" problem. I selected this particular algorithm because it can be easily programmed and, also, because of the recently renewed interest in it (Ref. 5 and Ref. 6).

This algorithm was first devised in 1823 by J.C. Warnsdorff, a German mathematician, and has been admired for its elegance and simplicity ever since.

The interest recently has been to implement it in program form so that certain ambiguities that may arise in its execution will be eliminated. The refinements proposed (Ref. 5, Ref. 6) apply only to an 8 x 8 board. In the discussion that follows a refinement that works for any size board is introduced along with its implementation in Basic.



The "Knight's Tour"

The "Knight's Tour" problem can be defined as follows: Given a board of n x n dimensions with n^2 squares, a knight—which must move according to the rules of chess—is placed on a particular square. The problem is to find a tour of n^2 -1 moves, if one exists, such that every square of the board is visited exactly once. Solutions for the "Knight's Tour" exist for boards 5 x 5 or larger. Boards with an even number of squares have tours starting from any square of the board, while boards with an odd number have tours from only those squares whose coordinates add up to an even number—(1,1), (5,3), etc.

This can be explained as follows: The squares on a board are alternately colored black and white. If the knight is on a white square, its next move must be made to a black square and vice versa. Also, on an odd-size board, the last step must be made on the same color square as the first step.

Let's take a look at the 5 x 5 board with 12 black squares and 13 white squares. If the first step is to be made on a white square, the knight will alternately step on 12 white squares and 12 black squares before it ends up in the 13th white square for a complete tour. If, however, its first move is on a black square, the last move can be made only on a black square, leaving at least one white square unvisited.

Solving the "Knight's Tour" problem was one of the favorite pastimes of the mathematicians of the 18th and 19th centuries. Euler, De Moivre, De Montmont, Vandermonde, Roget, and Warnsdorff, among others, tackled with the "Knight's Tour" and produced their own solutions. Some of them used trial and error techniques. Others, like Euler, attempted to introduce mathematical analysis to come up with more sophisticated solutions. The complexity of the problem limited most of their algorithms to board sizes up to 10 x 10.

The advent of computers made it appealing to attempt to solve this centuries-old problem by using raw machine power. Trial and error techniques, such as backtracking, presented a less formidable task for machines than they did for humans.

Backtracking is a trial and error algorithm that can be easily translated into program form. When applied to the "Knight's Tour" problem, it works in the following way: The knight follows a path, each step of which is selected on the basis of a simple rule. If there are two or more squares to choose from, take the first one clockwise and move on to the next step. If this path comes to a dead-end, backtrack one step and follow the second available square in the same clockwise fashion. Repeat this procedure until a solution is found or all possible moves are exhausted.

Obviously, such an algorithm does not take into account the nature of the problem at all. A solution can be produced quickly only if it happens that the path chosen at the beginning is the correct path. In the worst case, all possible paths must be examined before a solution is found, while on the average, half of the paths must be examined.

An implementation of such a backtracking algorithm in Pascal and its subsequent execution on a PDP 11/70 showed that a solution could be found for a 5 x 5 board in 52.5 seconds, and for a 6 x 6 board in 2.5 minutes. Likewise, a 7 x 7 board would require 1/2 hour, an 8 x 8 board would take three hours, and for a 20 x 20 board exclusive use of the PDP 11/70 for days would be necessary!

It is obvious that this algorithm is useless for large boards, as is the case for exponential time algorithms when the problem size increases.

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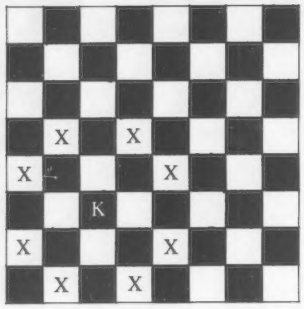

Figure 1. A knight's possible moves.

Figure 2. First order weight of each square of an 8 x 8 board after knight was placed on square (2,3).

-2	-3	-4	-4	-4	-4	-3	-2
-3	-4	-6	-6	-6	-6	-4	-3
-4	-6	-8	-8	-8	-8	-6	-4
-3	-6	-7	-8	-8	-8	-6	-4
-4	-6	-8	-7	-8	-8	-6	-4
-4	1	-8	-8	-8	-8	-6	-4
-3	-4	-6	-5	-6	-6	-4	-3
-1	-3	-3	-4	-4	-4	-3	-2

A Simple But Ingenious Algorithm

The algorithm proposed by Warnsdorff in 1823 recognizes the need for a deeper examination of each board position. Before taking a step from a given square, all squares that are potential candidates for the next move (those within the range of the knight that have not been visited) are evaluated. This evaluation is based on the number of free squares that are available for a subsequent move from each of the candidate squares. The square that has the fewest accesses open to it is selected.

This first order-weighting algorithm has not, as yet, been proven mathematically, but has not been shown to fail either. Intuitively it seems, however, that by moving to the square with the least degree of freedom, the chances of leaving squares isolated at a corner of the board, or finding the knight cornered at a dead-end, are reduced.

Warnsdorff's algorithm, though hailed for its ingenuity, has been criticized on two accounts: first, because it is difficult to implement in practice on an actual chess board and, second, and most importantly, because it may fail if there are two or more squares with the same minimum weight—a first-order tie—and the wrong square is selected.

Interestingly, Warnsdorff thought it did not really matter which path was selected in case of such a tie. Later on, however, a handful of examples were constructed, after "much effort and ingenuity" (Ref. 7), that showed the tour to fail if the wrong square was chosen. Since Warnsdorff and the other mathematicians of that time did not have computers to aid them in their analysis, it was extremely difficult to test all tours from every square of a board and exhaustively examine all possibilities resulting from a given tie. Nowadays, this task is much easier, of course. It must be noted here, again, that those failing cases are not due to a problem in the original algorithm itself, but rather to the lack of a suitable second order tiebreaker.

The board representation difficulty cited in the past can be easily eliminated using the "poker-chip" method. The whole board is evaluated at the very beginning. Each square is examined to find how many free squares it connects to, and the corresponding number in poker chips is placed on it. During the knight's tour a chip is removed from all of the affected squares after a step is taken. A square found with zero chips on other than the n^2-1 step shows that that square was left isolated and the board can never be totally visited (a nice program terminating condition). In an actual program, the poker chips can be represented by negative numbers, and positive numbers used to show the step number. Figure 2 shows the 8 x 8 board after the first step to square (2,3).

The second difficulty with Warnsdorff's algorithm is due to lack of a suitable tie-breaker for a first-order tie. This problem is addressed in Refs. 5 and 6, but the proposed tie-breakers can only apply for boards of size 8 x 8.

One of these tie-breakers (Ref. 5) employs an arbitrary clockwise selection rule on the squares with equal weight. If that rule fails to produce a solution, the tour is repeated from the beginning using a counter-clockwise selection rule. The other tie-breaker (Ref. 6) takes into account the second order weight of each square, defined as the sum of the first order weights of all squares accessible to it at the beginning of the tour (the second order weights do not change during the course of the tour as happens with the first order weights).

Since these tie-breakers may fail for any size board, I started looking for a more universal tie-breaker. Several different tie-breakers were tried, such as minimum second order weight (but adjustable during the course of the tour), maximum second order weight, the square closest to the edge of the board, the square farthest away from the edge of the board, etc., but did not produce the desired result. It was possible, however, to use a combination of two such tie-breakers (if the one failed, then the tour was restarted using the second one) that has always produced a solution, when one existed, for any square board of 5 x 5 to 20 x 20. (Exhaustive tests were not

Figure 3a.

-2	2	-4	8	-2
-3	7	-4	3	-3
1	-4	-4	-4	9
6	-4	-2	-4	4
-2	-2	5	-2	-2

Figure 3b.

-2	2	-4	8	-2
-3	7	-4	3	-3
1	-4	-4	-4	9
6	-4	10	-4	4
-1	-2	5	-2	-1

Figure 3c.

15	2	-2	8	13
-3	7	14	3	-3
1	16	-4	12	9
6	-2	10	-2	4
17	-2	5	-2	11

Figure 3d.

-2	2	-4	8	-2
-3	7	-4	3	-3
1	-4	-3	-4	9
6	-3	-2	-4	4
-2	-2	5	10	-2

Figure 3e.

21	2	17	8	19
12	7	20	3	16
1	22	13	18	9
6	11	24	15	4
23	14	5	10	25

Figure 3. The difference between the two tie-breaker rules is shown on a 5 x 5 board and tour starting coordinates at square (1,3). Both rules follow the same path up to the ninth step (Figure 3a), where a first order tie is encountered. The "min-max" tie-breaker examines the squares with the minimum weight tie to find the next step square available to each of them with the maximum weight. Then it selects that first order square having the second order square with the minimum weight among all maximum weights. Thus square (3,2) (Figure 3b) is selected with a weight of 2 over square (4,1) which has a weight of 4. This path leads to no solution. (Figure 3c). The "max-min" tie-breaker (the maximum of the minimum of the second order square weights) is then tried, and selects square (4,1) (Figure 3d). This path does produce a solution as shown in Figure 3e.

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```
ENTER SIZE OF BOARD         ? 20
ENTER STARTING LOCATION, X-COORDINATE
? 15
ENTER STARTING LOCATION, Y-COORDINATE   ? 12

SOLUTION
----------

  29   26   31  188  297   24  193  186  289   22  183  130  125   20   13  114   15    6   11    8
  32  189   28   25  192  187  298   23  194  185  288   21  182  129  124   19   12    9   16    5
  27   30  191  296  335  368  293  332  299  290  195  184  131  126  115   14  113   18    7   10
 190   33  336  395  294  357  334  367  292  331  276  287  128  181  132  123   58   61    4   17
 337  394  295  358  381  386  369  356  333  300  291  196  179  274  127  116    3  112   57   60
  34  359  396  391  398  377  382  315  366  277  330  275  286  197  180  133  122   59   62   65
 393  338  399  378  385  380  387  370  355  314  301  204  273  178  241    2  117   64  111   56
 360   35  392  397  390  383  376  365  316  329  278  285  240  205  198  177  134  121   66   63
 339  400  373  384  379  388  371  354  313  302  231  272  203  242    1  206  175  118   55  110
  36  361  340  389  372  375  364  317  328  279  284  239  230  233  176  199  144  135  120   67
 341  348  351  374  363  326  353  312  303  238  271  232  243  202  207  174  119  106  109   54
 350   37  362  343  352  311  318  327  280  283  248  227  234  229  200  145  136  143   68  107
 347  342  349  322  325  344  281  304  249  270  237  244  201  208  173  160  105  108   53   94
  38  321  324  345  310  319  258  269  282  247  226  235  228  161  146  137  142   95   90   69
 265  346  309  320  323  268  305  250  225  236  245  164  209  172  159  102   89  104   93   52
 308   39  264  267  306  257  220  259  246  165  210  171  162  147  138  141   96   87   70   91
 263  266  307  256  219  260  251  224  211  170  163  148  139  158  101   88  103   92   51   74
  40  255  216  261  252  221  212  169  154  151  166  157  100   79  140   97   86   73   82   71
 215  262  253   42  213  218  223   44  167  156  153   46  149   98   77   48   81   84   75   50
 254   41  214  217  222   43  168  155  152   45  150   99   78   47   80   85   76   49   72   83
```

Figure 4.

run for boards of size greater than 20 x 20; however, the nature of the problem suggests that this algorithm may apply on any size board).

The first of these two tie-breakers, "min-max," examines the squares with the minimum weight tie to find the next step square available to each of them with the maximum weight. Then it selects that first order square having the second order square with the minimum weight among all maximum weights. The second tie-breaker, "maximum," selects the square with the maximum among the minimum weights of the second order squares (Figure 3).

This tie-breaker is implemented in the Basic program shown. Its execution time increases linearly with the number of squares to be visited on the board, as it involves no backtracking. In the worst case, when both tie-breakers are used, the execution time is proportional to twice the number of squares. This means that if an 8 x 8 board takes four seconds of CPU time, a 20 x 20 board will take only 25 seconds while a 50 x 50 board will take about seven minutes. Execution times vary, depending on the computer it is run on.

So, this combination of tie-breakers can be successfully used in conjunction with Warnsdorff's algorithm to solve the "Knight's Tour" problem for any size board in reasonable program run times. Has this problem, then, been completely solved? Well, not quite yet. There is still the question of whether a single universal tie-breaker exists that can be implemented on any square or rectangular board, and, if that tie-breaker does exit, can Warnsdorff's algorithm be used to solve similar problems?

Whatever the answer to these questions may be, I hope that the "Knight's Tour" problem and Warnsdorff's algorithm have demonstrated, that ingenuity in algorithm design and computer programming in general, can be the most effective approach to computer game playing and the solution of complex problems. This is emphasized, of course, without overlooking the fact that generating a "Knight's Tour" with the above algorithm on a PDP 11/70 computer for a board of size 20 x 20 (Figure 4) takes less than one minute—a time that Warnsdorff could have never imagined, even in his wildest of dreams! □

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```
10 REM                    "THE KNIGHT'S TOUR"
20 REM                          BY
30 REM                    CHRISTOS J. GEORGIOU
40 REM
50 REM
80 REM
90 REM   PARAMETER INITIALIZATION
100 REM
110 DIM H(25,25), A(8), B(8), P0(8), P1(8)
120 A(1)=1: B(1)=2: A(2)=2: B(2)=1
130 A(3)=2: B(3)=-1: A(4)=1: B(4)=-2
140 A(5)=-1: B(5)=-2: A(6)=-2: B(6)=-1
150 A(7)=-2: B(7)=1: A(8)=-1: B(8)=2
160 INPUT "ENTER SIZE OF BOARD",N
170 INPUT "ENTER STARTING LOCATION, X-COORDINATE",X1
180 INPUT "ENTER STARTING LOCATION, Y-COORDINATE",Y1
190 A1=1: N1=N*N
200 REM  CLEAR BOARD
210 REM
220 FOR I=1 TO N
230 FOR J=1 TO N
240 H(I,J)=0
250 NEXT J: NEXT I
260 FOR I=1 TO N
270 FOR J=1 TO N
280 X=I: Y=J: GOSUB 900
290 NEXT J: NEXT I
300 REM
310 REM   MAKE FIRST MOVE
320 REM
330 X=X1: Y=Y1
340 H(X,Y)=1: L=2
350 GOSUB 1000
360 Q1=1: Q2=1
370 REM
380 REM   ROUTINE THAT FINDS NEXT MOVE
390 REM
400 IF (Q1=0) OR (Q2=0) GOTO 730
410 Q1=0: Z1=X: Z2=Y: GOSUB 1200
420 IF (R0>1) GOTO 450
430 C1=T1: C2=T2
440 GOTO 640
450 REM  EXAMINE ALL TIES
460 FOR K=1 TO R0
470 P1(K)=P0(K)
480 NEXT K
490 R1=R0
500 IF A1=1 GOTO 520
510 M2=0: GOTO 530
520 M2=-9
530 FOR K=1 TO R1
540 F1=P1(K): Z1=X+A(F1): Z2=Y+B(F1)
550 IF (A1=1) GOTO 590
560 GOSUB 1200
570 IF (M1>=M2) GOTO 620
580 GOTO 610
590 GOSUB 1400
600 IF (M1<=M2) GOTO 620
610 M2=M1: C1=Z1: C2=Z2
620 NEXT K
630 REM
640 REM  NEXT MOVE IS FOUND; UPDATE BOARD
650 REM
660 IF (Q1=0) GOTO 710
670 X=C1: Y=C2
680 H(X,Y)=L
690 GOSUB 1000
700 IF (L=N1) THEN Q2=0
710 L=L+1
720 GOTO 400
730 REM
740 REM   KNIGHT'S TOUR IS OVER; PRINT RESULTS
750 REM
760 IF (Q2=1) GOTO 810
770 PRINT: PRINT "SOLUTION"
780 PRINT "----------";
790 GOSUB 1600
800 GOTO 1800
810 IF (A1=0) GOTO 830
820 A1=0: GOTO 200
830 PRINT: PRINT "NO SOLUTION"
840 GOTO 1800
890 REM
900 REM   BOARD INITIALIZATION ROUTINE
910 REM
920 FOR I1=1 TO 8
930 U=X+A(I1): V=Y+B(I1)
940 IF (U>0) AND (U<=N) GOTO 960
950 GOTO 990
960 IF (V>0) AND (N<=N) GOTO 980
970 GOTO 990
980 H(U,V)=H(U,V)-1
990 NEXT I1: RETURN
1000 REM
1010 REM   BOARD UPDATING ROUTINE
1020 REM
1030 B=1
1040 FOR I1=1 TO 8
1050 U=X+A(I1): V=Y+B(I1)
1060 IF (U>0) AND (U<=N) GOTO 1080
1070 GOTO 1130
1080 IF (V>0) AND (V<=N) GOTO 1100
1090 GOTO 1130
1100 IF H(U,V)<=0 GOTO 1120
1110 GOTO 1130
1120 H(U,V)=H(U,V)+1: B=0
1130 NEXT I1
1140 IF B1=1 THEN Q1=0
1150 RETURN
1200 REM
1210 REM   ROUTINE THAT SEARCHES FOR NEXT MOVE WITH MINIMUM WEIGHT
1220 REM
1230 M1=-9: R0=1
1240 FOR W=1 TO 8
1250 U=Z1+A(W): V=Z2+B(W)
1260 IF ((U>0) AND (U<=N)) AND ((V>0) AND (V<=N)) GOTO 1280
1270 GOTO 1360
1280 IF ((H(U,V)<=0) AND (H(U,V)>=M1)) GOTO 1300
1290 GOTO 1360
1300 IF (H(U,V)=M1) GOTO 1350
1310 M1=H(U,V): Q1=1
1320 T1=U: T2=V
1330 R0=1: P0(1)=W
1340 GOTO 1360
1350 R0=R0+1: P0(R0)=W
1360 NEXT W
1370 RETURN
1400 REM
1410 REM   ROUTINE THAT SEARCHES FOR NEXT MOVE WITH MAXIMUM WEIGHT
1420 REM
1430 M1=0: R0=1
1440 FOR W=1 TO 8
1450 U=Z1+A(W): V=Z2+B(W)
1460 IF ((U>0) AND (U<=N)) AND ((V>0) AND (V<=N)) GOTO 1480
1470 GOTO 1560
1480 IF ((H(U,V)<=0) AND (H(U,V)<=M1)) GOTO 1500
1490 GOTO 1560
1500 IF (H(U,V)=M1) GOTO 1550
1510 M1=H(U,V): Q1=1
1520 T1=U: T2=V
1530 R0=1: P0(1)=W
1540 GOTO 1560
1550 R0=R0+1: P0(R0)=W
1560 NEXT W
1570 RETURN
1600 REM
1610 REM   ROUTINE THAT PRINTS-OUT BOARD
1620 L2=N
1630 FOR I2=1 TO N
1640 PRINT: PRINT
1650 FOR L1=1 TO N
1660 S1=H(L1,L2)
1670 IF S1<10 GOTO 1710
1680 IF S1<100 GOTO 1700
1690 D1=0: GOTO 1720
1700 D1=1: GOTO 1720
1710 D1=2
1720 PRINT SPACE$(D1); S1;
1730 NEXT L1
1740 L2=L2-1
1750 NEXT I2
1760 RETURN
1800 PRINT
1810 END
```

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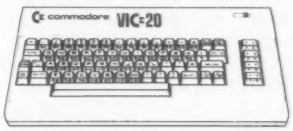

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CIRCLE 136 ON READER SERVICE CARD

Upper and Lower Case for Your Model-I

David Yon

You've just received your TRS-80 with its new lower-case modification. You decided to go for it and get the good one from Radio Shack with the true descenders. You plug everything back in and decide to experiment with your new capability before doing anything serious.

Just load the lower-case driver in (what a strange filename), and you're in business. Look at those letters in lower case. How did you ever get along without it? All is well, correct? Maybe not.

While the lower-case kit on the whole is excellent (though a bit over-priced), the driver that Radio Shack supplies has some inherent problems. First, it eats up several hundred bytes of memory which means that if you want to type in an adventure or other long program using lower case, there may not be room.

Also, what about shifting between all-caps and the upper/lower case mode? I find it extremely awkward to hit the shift and "0" keys at the same time. These are but a few of the discoveries that you make the first time you load this little utility.

You shrug off the disadvantages and decide to type in a program from *Creative Computing*. So you load the driver, then TSHORT, and get down to business. Wait a minute. Why don't the keywords appear when you type a shift-letter, even when you're in the all-caps mode? This new driver seems to be shutting off TSHORT. So you load TSHORT without the driver.

But wait. You wanted this program in lower case. So you just have to type in the program without using TSHORT, but then you've wasted money on an extremely helpful utility that you can't use any more.

David Yon, R.D. #1-168, Richmond, VT 05477.

A close look reveals that the driver has also shut off the control characters available with the "new-ROM" Level-IIs (shift-down arrow-C enters a control-C from the keyboard.)

Well, now you can forget about that uncooperative driver. The driver that frustration forced me to write eliminates all of those problems.

First, it takes no memory (that's right, it resides in low memory below your program space), which means that you have given up none of your precious memory space, and also means that it will run on any size system, won't clash with any high-memory printer drivers, etc., and won't interfere with other programs such as TSHORT.

Second, it toggles the shift-lock with the shift-right arrow, which is much easier on the fingers and prevents accidentally going into double width. (However, it does mean you will lose the TAB keyword from TSHORT. Also you can still run TSHORT, and turn it off and on with a single keystroke. Lastly, any other special feature that your particular keyboard has will still be there.

To use the driver, merely type and assemble the source code, and put it on tape. Now, everytime you want to power-up in Basic, simply make it a habit to load the lower-case driver first.

All you have to do is type SYSTEM, then the filename that you specified when you assembled the driver. When the driver is loaded, simply hit Break to enter Basic.

When you first load the driver, you are locked into all-caps (actually, all-caps is the normal mode for the TRS-80 keyboard, where you press shift to get lower-case). To shift between all-caps and upper/lower (typewriter) keyboard, hit shift-right arrow. Notice that you don't enter double-width, a feature I consider more of a blessing than a fault. Notice, too, that if you have the new ROM, you will still be able to enter control characters.

I seriously doubt that the driver will work on disk as-is, you will probably have to relocate it somewhere else if you want to use it with a disk system.

Things become a bit more complicated if you want to use TSHORT with the driver, however. To make it easier, I put a copy of TSHORT directly after a copy of the driver (an example of a legal use for System Copy).

To power-up with lower case and TSHORT, just type SYSTEM and the filename of the driver, and let the driver load. After it loads, type TS and let TSHORT load. Now start TSHORT as before.

Notice that TSHORT functions exactly as before when first loaded. However, when you hit the shift-down arrow, you enter the lower-case keyboard mode, and TSHORT is effectively shut off. To return to the TSHORT keyboard, hit the toggling keystroke again; you can have lower case and TSHORT running at the same time,

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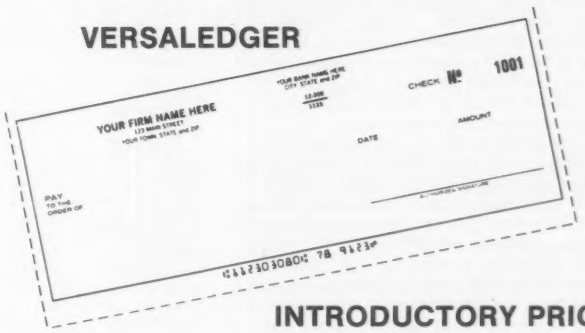

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CIRCLE 143 ON READER SERVICE CARD

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Some of the problems are not new like the one asking how much the $24 the Indians were paid for Manhattan would be worth today had it been deposited in a bank. However, this problem was revised to have a variable interest rate so it would be a challenge to program. Of course, many of the problems are new and have never been in print before.

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creative computing

Upper/Lower Case, continued...

and toggle between them with a single keystroke. Note that you must load the driver first, or TSHORT will not work. As a matter of fact, if you load anything that taps into the keyboard or video routines in the ROM, you should load the driver first if you plan to use it.

The Program

Referring to the listing, lines 120-140 contain the pointers to direct Basic to our routine, they load directly into memory with the rest of the program.

Lines 160-280 contain the video routine which is almost identical to the one found in ROM, except that it doesn't test for and screen out lower-case characters, as it displays any size letter.

The remaining lines function as follows:

Line 290 calls the ROM keyboard routine.

Line 300 tests for no keystroke.

Line 320 loads HL with the location of the flag byte (0=shift lock, 255=typewriter).

Line 330 tests for the shift-down arrow, and activates the shift-lock.

Line 360 gets the flag byte, tests for shift-lock, and returns the keystroke "as-is."

If the program gets as far as lines 400 to 430 these lines check to see if we are dealing with a letter.

If we have a letter, line 440 will change an upper-case letter to lower-case and vice versa.

The routine beginning with line 460, the shift-lock routine, toggles the flag byte between 0 (all-caps) and 255 (upper/lower case).

There are several possibilities for indirect control over my routine. First, you can change the shift-lock keystroke by changing the value in line 330 to the value of your new keystroke. Or, to allow program control over the mode the keyboard is in, change memory location 16408 to 0 for upper case only (for answering "Y" or "N" for example), and to 255 for the typewriter mode (for typing in a person's name, etc.). To lock the keyboard into either mode, set 16408 (as described above), then set 16485 to 0. To allow the user to control the mode again, return 16485 to 25. As a final short-cut, to lock the computer into lower case without changing 16485 and doing two POKEs, set 16408 to any number between 254 and 1. □

```
                00100 ;LOWER CASE DRIVER 2.0
4016            00110          ORG     4016H
4016 5C40       00120          DEFW    KYBD        ;KEYBOARD ROUTINE
0006            00130          DEFS    6
401E 3E40       00140          DEFW    VIDEO       ;VIDEO ROUTINE
403E            00150          ORG     403EH
403E DD6E03     00160 VIDEO    LD      L,(IX+3)    ;VIDEO DRIVER****
4041 DD6604     00170          LD      H,(IX+4)    ;CURSOR POS TO HL
4044 DA9A04     00180          JP      C,49AH      ;HOUSEKEEP
4047 DD7E05     00190          LD      A,(IX+5)    ;GET CURSOR CHAR
404A B7         00200          OR      A           ;TEST FOR NULL
404B 2801       00210          JR      Z,V1        ;GO IF NULL
404D 77         00220          LD      (HL),A      ;PUT CHAR IN IT'S PLACE
404E 79         00230 V1       LD      A,C         ;GET NEXT CHAR
404F FE20       00240          CP      20H         ;CNTRL?
4051 DA0605     00250          JP      C,506H      ;CNTRL ROUTINE
4054 FEC0       00260          CP      0C0H        ;SPACE COMPRESSION?
4056 D2AA04     00270          JP      NC,4AAH     ;IF SO.....
4059 C37D04     00280          JP      47DH        ;PRINT IT
405C CDE303     00290 KYBD     CALL    03E3H       ;KEYBOARD DRIVER****
405F B7         00300          OR      A           ;TEST FOR NULL
4060 C8         00310          RET     Z           ;NO KEYSTROKE
4061 211840     00320          LD      HL,4018H    ;FLAG BYTE POINTER
4064 FE19       00330          CP      25          ;SHIFT LOCK?
4066 280F       00340          JR      Z,K1        ;LOCK ROUTINE
4068 47         00350          LD      B,A         ;SAVE
4069 7E         00360          LD      A,(HL)      ;LOWERCASE FLAG BYTE
406A B7         00370          OR      A           ;TEST FOR LOWERCASE
406B 78         00380          LD      A,B         ;RESTORE BYTE
406C C8         00390          RET     Z           ;LEAVE BYTE ALONE
406D FE60       00400          CP      96          ;LOWERCASE?
406F 3003       00410          JR      NC,K2       ;YES.....
4071 FE40       00420          CP      64          ;LETTER?
4073 D8         00430          RET     C           ;RETURN IF NOT
4074 EE20       00440 K2       XOR     20H         ;COMPENSATE
4076 C9         00450          RET                 ;RETURN
4077 3EFF       00460 K1       LD      A,255       ;INVERTER BYTE
4079 AE         00470          XOR     (HL)        ;INVERT IT
407A 77         00480          LD      (HL),A      ;PUT BACK
407B AF         00490          XOR     A           ;ZERO
407C C9         00500          RET                 ;RETURN
06CC            00510          END     06CCH
00000 TOTAL ERRORS
K2      4074
K1      4077
V1      404E
VIDEO   403E
KYBD    405C
```

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8	DEPRSY	Sum of the digits depreciation
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10	DEPRDDB	Double declining balance depreciation
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12	CHECK2	Prints NEBS checks along with daily register
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14	MORTGAGE/A	Mortgage amortization table
15	MULTMON	Computes time needed for money to double, triple, etc.
16	SALVAGE	Determines salvage value of an investment
17	RRVARIN	Rate of return on investment with variable inflows
18	RRCONST	Rate of return on investment with constant inflows
19	EFFECT	Effective interest rate of a loan
20	FVAL	Future value of an investment (compound interest)
21	PVAL	Present value of a future amount
22	LOANPAY	Amount of payment on a loan
23	REGWITH	Equal withdrawals from investment to leave 0 over
24	SIMPDISK	Simple discount analysis
25	DATEVAL	Equivalent & nonequivalent dated values for oblig.
26	ANNUDEF	Present value of deferred annuities
27	MARKUP	% Markup analysis for items
28	SINKFUND	Sinking fund amortization program
29	BONDVAL	Value of a bond
30	DEPLETE	Depletion analysis
31	BLACKSH	Black Scholes options analysis
32	STOCVAL1	Expected return on stock via discounts dividends
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NAME	**DESCRIPTION**	
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66	PRINDPA	Paasche price index
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69	TIMEMOV	Time series analysis moving average trend
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72	LETWRT	Letter writing system-links with MAILPAC
73	SORT3	Sorts list of names
74	LABEL1	Shipping label maker
75	LABEL2	Name label maker
76	BUSBUD	DOME business bookkeeping system
77	TIMECLCK	Computes weeks total hours from timeclock info.
78	ACCTPAY	In memory accounts payable system-storage permitted
79	INVOICE	Generate invoice on screen and print on printer
80	INVENT2	In memory inventory control system
81	TELDIR	Computerized telephone directory
82	TIMUSAN	Time use analysis
83	ASSIGN	Use of assignment algorithm for optimal job assign.
84	ACCTREC	In memory accounts receivable system-storage ok
85	TERMSPAY	Compares 3 methods of repayment of loans
86	PAYNET	Computes gross pay required for given net
87	SELLPR	Computes selling price for given after tax amount
88	ARBCOMP	Arbitrage computations
89	DEPRSF	Sinking fund depreciation
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CIRCLE 144 ON READER SERVICE CARD

Printer Control Codes From Within Apple Writer

J. Michael Riley

To Apple II owners whose machines are equipped with a Dan Paymar Lower Case Adapter and use Apple Writer, I highly recommend modifying the program to display lower case directly on the screen as described by John E. Stith in the February 1981 issue of *Creative Computing*. I have used the modified version for over a year and have had no problems whatever.

If your printer has the capability of varied print fonts, as mine does, you may have wondered how to send the printer the necessary control codes from within Apple Writer texts. The difficulty with direct entry of these control codes (usually ASCII control characters) is that the Apple Writer TEDITOR program uses control codes entered from the keyboard to maneuver the cursor during editing, thus effectively preventing the user from entering them into the body of the text.

I use a prehistoric IDS IP-225, which can produce enhanced (double-width) or normal characters in four different print densities under software control. The printer will also perform a carriage return without linefeed, which can be used for double-striking for emphasis, and a 1/3 linefeed, which can be used for underlining with the hyphen.

To embed these control codes in texts, you must place the necessary ASCII hexadecimal codes directly into the portion of the memory of your computer that the Apple Writer program uses for the text. The easiest way to do this is as follows:

1. Boot your system with the Apple Writer disk modified as directed in Mr. Stith's article. (The unmodified program will not work using this technique because of the way both the TEDITOR and PRINTER programs interpret and display the text memory.)

J. Michael Riley, 619 N. Cascade Ave., Suite 3, Colorado Springs, CO 80903.

2. Exit the program by pressing Q Return.

3. Enter the Apple system monitor by typing CALL -151 Return.

4. Type 1900: 83 01 02 1C 1D 1E 1F 0B 09 4B 0D 60 Return. This builds a short text in memory where Apple Writer expects to find it. Hex 83 is the beginning marker, and hex 60 is the end marker of the file. In between are the hex equivalents of the appropriate printer control codes for my printer (and many others) as follows:

01 = Control A = Enhanced Mode
02 = Control B = Normal Mode
1C = Control / = 8.3 Characters/inch
1D = Control] = 10 Characters/inch
1E = Control ↑ = 12 Characters/inch
1F = Control < = 16.5 Characters/inch
0B = Control K = Vertical Tab (1/3 line feed)
09 4B turns off the Apple Parallel Card automatic linefeed
0D = Control M = Carriage Return

These control codes may not be applicable to your printer or printer controller card; check your manual.

5. Type 3D0G Return to re-enter Basic.

6. Type BRUN TEDITOR Return.

7. After the editor program is loaded, and the menu appears, type E Return. The text on the screen will consist of a block of inverse characters, and one flashing one (a K). Using the normal Apple Writer editing techniques, you may now add a brief explanation of each code for easier reading and use. Return to the Apple Writer menu and type S Return. Save the control codes as you would any other Apple Writer file. I saved mine right on the working master diskette under the imaginative name CONTROL CODES.

8. You may now insert any of these desired control codes within your own text by parking the cursor where you want the code, and using the Apple Writer "insert" command (Control I). When the editor asks which file to insert, respond with CONTROL CODES (or whatever name you have chosen). Then simply delete the control codes you do not want.

(Editor's Note—Readers may wish to make a series of files, with one for each control function. This way, no deletions will be required when a control file is inserted.)

I have used these codes with great success, although several of them required some experimentation before I got predictable results. For example, my printer is set up so that the controller card issues the linefeed automatically with every carriage return. This is defeated as directed in the documentation for the card, and as noted above.

Turning off the linefeed is useful for over-striking and forming composite characters. However, unless the automatic linefeed is turned back on again, the entire remainder of the text is printed with no paper advance—not too legibly, I might add. The card documentation does not specify how to restore automatic linefeed, but it happens to be with the same code as is used to turn it off.

Another subtlety of an embedded character for carriage return is that the print head returns completely to the left margin regardless of the Apple Writer margin setting. The spaces used for margin setting must be accounted for when setting up underlines or over-strikes.

This simple technique will allow you to access many of the special capabilities of your printer from within Apple Writer. It also has one unique and exciting advantage over commercially available software—it's free! □

It's hard to picture all of DYNACOMP's *software*

GIN RUMMY

SHAPE MAGICIAN

CHESSMASTER

BLACK HOLE

MIDWAY

FOURIER ANALYZER

RINGS OF THE EMPIRE

LEM LANDER

STOCKAID

HODGE PODGE

FOREST FIRE

QUINTOMINOES

STARTREK 3.2

GO FISH

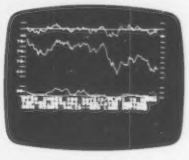
HARMONIC ANALYZER

CHECKERS 3.0

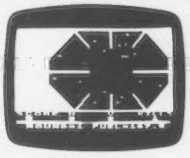
HODGE PODGE

TRIPLE BLOCKARD

CHOMPELO


NYINDEX

TEACHER'S AIDE


SPACE TRAP

STOCK MASTER
STOCK PLOT

BACCARAT

SUPER SUB CHASE

MAIL MASTER

VALDEZ (MAP)

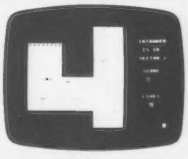
STOCK MASTER
STOCK PLOT

GIN RUMMY

SPACE LANES

ESCAPE FROM
VOLANTIUM

BREAKUP


INTRUDER ALERT

PERSONAL FINANCE
SYSTEM

CRYSTALS

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TURN TO NEXT PAGE...

CIRCLE 159 ON READER SERVICE CARD

DYNACOMP

Quality software for:*

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OSBORNE-1
ALTAIR****

TRS-80 (Level II)**
NORTH STAR***
CP/M Disks/Diskettes
(See Availability box MBASIC/CBASIC)
SUPERBRAIN*****

CARD GAMES

NEW **BRIDGE MASTER (North Star only)** Price: $21.95 Diskette
If you liked DYNACOMP'S BRIDGE 2.0, you will absolutely love BRIDGE MASTER. BRIDGE MASTER is a comprehensive bridge program designed to provide hours of challenging competition. Bidding features include the Blackwood convention, Stayman convension, pre-emptive openings, and recognition of demand bids and jump-shift responses. After playing a specific hand, you may replay the same hand, with the option of switching cards with your computer opponents. This feature allows you to compare your bidding and playing skills to BRIDGE MASTER. Bonuses for game contracts and slams are awarded as in duplicate bridge. Doubled contracts are scored based upon a computer assigned vulnerability. A score card is displayed at the conclusion of each hand. The score card displays a summary of total hands played, total points scored, number of contracts made and set, and % bids made. BRIDGE MASTER is clearly the best computer bridge program available.
DYNACOMP'S previous BRIDGE 2.0 customers may upgrade to BRIDGE MASTER for a nominal charge of $5.00 plus postage and handling (see ordering information box).

NEW NEW **BACCARAT (Atari only)** Price: $18.95 Cassette/$22.95 Diskette
This is the European card game which is the favorite of the Monte Carlo jet set. Imagine yourself at the gaming table with 007 to your left and Goldfinger to your right. Learn and play BACCARAT at your leisure on the Atari. Contains full high resolution color graphics and matching sound. Runs in 16K. Requires one joystick.

NEW NEW **GIN RUMMY (Apple diskette only)** Price: $22.95 Diskette
This is the best micro computer implementation of GIN RUMMY existing. The computer plays exceptionally well, and the HIRES graphics are superb. What else can be said?

NEW NEW **POKER PARTY (Available for all computers)** Price: $17.95 Cassette/$21.95 Diskette
POKER PARTY is a draw poker simulation based on the book, POKER, by Oswald Jacoby. This is the most comprehensive version available for microcomputers. The party consists of yourself and six other (computer) players. Each of these players (you will get to know them) has a different personality in the form of a varying propensity to bluff or fold under pressure. Practice with POKER PARTY before going to that expensive game tonight! Apple cassette and diskette versions require a 32 K (or larger) Apple II.

NEW NEW **GO FISH (Available for all computers)** Price: $14.95 Cassette/$18.95 Diskette
GO FISH is a classic children's card game. The opponent is a friendly computer with user inputs that are simple enough for small children to easily master. The Apple and Atari versions employ high resolution graphics for the display of hands. A must for children!

NEW NEW **BLACKJACK COACH (32K TRS-80 only)** Price $29.95 Cassette/$33.95 Diskette
BLAGKJACK COACH is both a game and an educational tool. With this program you may quantitatively test standard and special playing and betting methods, including the several card count schemes. You can simply play, play with the computer as a coach, or statistically test your method under long run automatic play. All the standard player choices are included: insurance, splitting pairs, double downs and surrender (optional). The computer analyzes the technique and provides detailed summary reports which statistically pinpoint the strengths and weaknesses of your play. Don't risk your money at the tables until you have practiced with BLACKJACK COACH!

THOUGHT PROVOKERS

MANAGEMENT SIMULATOR (Atari, North Star, OSBORNE and CP/M only) Price: $19.95 Cassette $21.95 Diskette
This program is both an excellent teaching tool as well as a stimulating intellectual game. Based upon similar games played at graduate business schools, each player or team controls a company which manufacturers three products. Each player attempts to outperform his competitors by setting selling prices, production volumes, marketing and design expenditures etc. The most successful firm is the one with the highest stock price when the simulation ends.

FLIGHT SIMULATOR (Available for all computers) Price: $17.95 Cassette/$21.95 Diskette
A realistic and extensive mathematical simulation of take-off, flight and landing. The program utilizes aerodynamic equations and the characteristics of a real airfoil. You can practice instrument approaches and navigation using radials and compass headings. The more advanced flyer can also perform loops, half-rolls and similar aerobatic maneuvers. Although this program does not employ graphics, it is exciting and very addictive. See the software review in COMPUTRONICS. Runs in 16K Atari.

VALDEZ (Available for all computers) Price: $15.95 Cassette/$19.95 Diskette
VALDEZ is a computer simulation of supertanker navigation in the Prince William Sound/Valdez Narrows region of Alaska. Included in this simulation is a realistic and extensive 256 × 256 element map, portions of which may be viewed using the ship's alphanumeric radar display. The motion of the ship itself is accurately modelled mathematically. The simulation also contains a model for the tidal patterns in the region, as well as other traffic (outgoing tankers and drifting icebergs). Chart your course from the Gulf of Alaska to Valdez Harbor! See the software review in 80 Software Critique and Personal Computing.

BACKGAMMON 2.0 (Atari, North Star, OSBORNE and CP/M only) Price: $14.95 Cassette/$18.95 Diskette
This program tests your backgammon skills and will also improve your game. A human can compete against a computer or against another human. The computer can even play against itself. Either the human or the computer can double or generate dice rolls. Board positions can be created or saved for replay. BACKGAMMON 2.0 plays in accordance with the official rules of backgammon and is sure to provide many fascinating sessions of backgammon play.

CHESS MASTER (North Star and TRS-80 only) Price: $19.95 Cassette/$23.95 Diskette
This complete and very powerful program provides five levels of play. It includes castling, en passant captures and the promotion of pawns. Additionally, the board may be preset before the start of play, permitting the examination of "book" plays. To maximize execution speed, the program is written in assembly language (by SOFTWARE SPECIALISTS of California). Full graphics are employed in the TRS-80 version, and two widths of alphanumeric display are provided to accommodate North Star users. See review in onComputing.

FOREST FIRE! (Atari only) Price: $14.95 Cassette/$18.95 Diskette
Using excellent graphics and sound effects, this simulation puts you in the middle of a forest fire. Your job is to direct operations to put out the fire while compensating for changes in wind, weather and terrain. Not protecting valuable structures can result in startling penalties. Life-like variables are provided to make FOREST FIRE! very suspenseful and challenging. No two games have the same setting and there are 3 levels of difficulty.

BLACK HOLE (Apple only) Price: $14.95 Cassette/$18.95 Diskette
This is an exciting graphical simulation of the problems involved in closely observing a black hole with a space probe. The object is to enter and maintain, for a prescribed time, an orbit close to a small black hole. This is to be achieved without coming so near the anomaly that the tidal stress destroys the probe. Control of the craft is realistically simulated using side jets for rotation and main thrusters for acceleration. This program employs Hi-Res graphics and is educational as well as challenging.

NEW **SPACE EVACUATION! (Apple, Atari and TRS-80 only)** Price: $15.95 Cassette/$19.95 Diskette
Can you colonize the galaxy and evacuate the Earth before the sun explodes? Your computer becomes the ship's computer as you explore the universe to relocate millions of people. This simulation is particularly interesting as it combines many of the exciting elements of classic space games with the mystery challenge of ADVENTURE.

MONARCH (Atari only) Price: $11.95 Cassette/$15.95 Diskette
MONARCH is a fascinating economic simulation requiring you to survive an 8-year term as your nation's leader. You determine the amount of acreage devoted to industrial and agricultural use, how much food to distribute to the populace and how much should be spent on pollution control. You will find that all decisions involve a compromise and that it is not easy to make everyone happy. Runs in 16K Atari.

CHOMPELO (Atari only) Price: $11.95 Cassette/$15.95 Diskette
CHOMPELO is really two challenging games in one. One is similar to NIM; you must bite off part of a cookie, but avoid taking the poisoned portion. The other game is the popular board game REVERSI. It fully uses the Atari's graphics capability, and is hard to best. This package will run on a 16K system.

AVAILABILITY

DYNACOMP software is supplied with complete documentation containing clear explanations and examples. Unless otherwise specified, all programs will run within 16K program memory space (ATARI requires 24K). Except where noted, programs are available on ATARI, PET, TRS-80 (Level II) and Apple (Applesoft) cassette and diskette as well as North Star single density (double density compatible) diskette. Additionally, most programs can be obtained on standard (IBM 3740 single density/double density compatible format) 8" CP/M floppy disks for systems running under MBASIC or CBASIC (for example, Altos, Xeros 820 and many others). 5¼" CP/M diskettes are available for the North Star and Osborne computer systems.

*ATARI, PET/CBM, NORTH STAR, CP/M, IBM, OSBORNE, SUPERBRAIN and XEROX are registered tradenames and/or trade marks.

**Except where noted, all TRS-80 Model I software is available on cassette (only) for the TRS-80 Model III. Exceptions: VALDEZ, CRIBBAGE, GRAFIX, CHESSMASTER. TRS-80 diskettes are not supplied with either DOS or BASIC.

***For most North Star disk-based systems. DYNACOMP presently does not support the new North Star Advantage.

****For Altair systems having Microsoft BASIC.

*****For SUPERBRAIN systems running under MBASIC or CBASIC (state which).

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NEW **STARTREK 3.2 (Available for all computers)** Price: $11.95 Cassette/$15.95 Diskette
This is the classic Startrek simulation, but with several new features. For example, the Klingons now shoot at the Enterprise without warning while also attacking starbases in other quadrants. The Klingons also attack with both light and heavy cruisers and move when shot at! The situation is hectic when the Enterprise is besieged by three heavy cruisers and a starbase S.O.S. is received! The Klingons get even! See the software reviews in A.N.A.L.O.G., 80 Software Critique and Game Merchandising.

NEW **LIL' MEN FROM MARS (Atari only)** Price: $19.95 Cassette/$33.95 Diskette
Defend yourself! The little men from Mars are out to get you if you don't get them first. This is a hilarious high resolution animated graphics (arcade) game which exercises much of the Atari's power. Requires one joystick.

NEW **SPACE TILT (Apple and Atari only)** Price: $10.95 Cassette/$14.95 Diskette
Use the game paddles to tilt the plane of the TV screen to "roll" a ball into a hole in the screen. Sound simple? Not when the hole gets smaller and smaller! A built-in timer allows you to measure your skill against others in this habit-forming action game.

NEW **ESCAPE FROM VOLANTIUM (Atari only)** Price: $15.95 Cassette/$19.95 Diskette
Bring the action and excitement of an arcade into your home with ESCAPE FROM VOLANTIUM! To escape you must maneuver your space ship around obstacles and laser blast the dragon (without being eaten). If he is killed with a direct shot (not just a leg lopped off), a door opens to the outside. However, the door does not stay open indefinitely. If you fail to escape in time, the door closes and a new dragon appears. Sometimes you can smash through the door by repeatedly chipping away at it. Other times it is impervious. At the higher levels of play more obstacles and dragons appear, adding to the excitement. Uses high resolution graphics and sound. Runs in 16K.

ALPHA FIGHTER (Atari only) Price: $13.95 Cassette/$16.95 Diskette
Two excellent graphics and action programs in one! ALPHA FIGHTER requires you to destroy the alien starships passing through your sector of the galaxy. ALPHA BASE is in the path of an alien UFO invasion; let five UFO's get by and the game ends. Both games require the joystick and get progressively more difficult the higher you score! ALPHA FIGHTER will run on 16K systems.

THE RINGS OF THE EMPIRE (Atari only) Price: $14.95 Cassette/$18.95 Diskette
The empire has developed a new battle station protected by rotating rings of energy. Each time you blast through the rings and destroy the station, the empire develops a new station with more protective rings. This exciting game runs on 16K systems, employs extensive graphics and sound and can be played by one or two players.

NEW **INTRUDER ALERT (Atari only)** Price: $14.95 Cassette/$18.95 Diskette
This is a fast paced graphics game which places you in the middle of the "Dreadstar" having just stolen its plans. The droids have been alerted and are directed to destroy you at all costs. You must find and enter your ship to escape with the plans. Five levels of difficulty are provided. INTRUDER ALERT requires a joystick and will run on 16K systems.

NEW **MIDWAY (Atari only)** Price: $14.95 Cassette/$18.95 Diskette
MIDWAY is an exciting extension of the game of Battleship. It mixes the challenges of strategy and chance. Your opponent can be another human or the computer. Color graphics and sound are both included. Runs in 16K.

NEW **TRIPLE BLOCKADE (Atari only)** Price: $14.95 Cassette/$18.95 Diskette
TRIPLE BLOCKADE is a two-to-three player graphics and sound action game. It is based on the classic video arcade game which millions have enjoyed. Using the Atari joysticks, the object is to direct your blockading line around the screen without running into your opponent(s). Although the concept is simple, the combined graphics and sound effect lead to "high anxiety".

GAMES PACK I (Available for all computers) Price: $10.95 Cassette/$14.95 Diskette
GAMES PACK I contains the classic computer games of BLACKJACK, LUNAR LANDER, CRAPS, HORSERACE, SWITCH and more. These games have been combined into one large program for ease in loading. They are individually accessed by a convenient menu. This collection is worth the price just for the DYNACOMP version of BLACKJACK.

GAMES PACK II (Available for all computers) Price: $10.95 Cassette/$14.95 Diskette
GAMES PACK II includes the games CRAZY EIGHTS, JOTTO, ACEY-DUCEY, LIFE, WUMPUS and others. As with GAMES PACK I, all the games are loaded as one program and are called from a menu. You will particularly enjoy DYNACOMP's version of CRAZY EIGHTS.

Why pay $7.95 or more per program when you can buy a DYNACOMP collection for just $10.95?

MOON PROBE (Atari and North Star only) Price: $11.95 Cassette/$15.95 Diskette
This is an extremely challenging "lunar lander" program. The user must drop from orbit to land at a predetermined target on the moon's surface. You control the thrust and orientation of your craft plus direct the rate of descent and approach angle. Runs in 16K Atari.

SPACE TRAP (Atari only, 16K) Price: $14.95 Cassette/$18.95 Diskette
This galactic "shoot'em up" arcade game places you near a black hole. You control your spacecraft using the joystick and attempt to blast as many of the alien ships as possible before the black hole closes about you.

NEW **CHIRP INVADERS (PET/CBM only)** Price: $14.95 Cassette/$18.95 Diskette
CHIRP INVADERS is an addictive game using action graphics. A Federation space station must be reached before the Chirps conquer the Earth. Stationary obstacles, moving meteors, and the attacking Chirps must all be avoided for a successful journey. Good luck.

NEW NEW **SUPER SUB CHASE (Atari only)** Price: $19.95 Cassette/$23.95 Diskette
SUPER SUB CHASE simulates a search and destroy mission. Set your course and keep an eye on the sonar readings as you hunt for the hidden submarine. Set the depth charge explosion depth and watch them sink towards the sub. This is an addictive game which takes advantage of the Atari's graphics and sound capabilities. One or two players. Joystick(s) required.

ADVENTURE

CRANSTON MANOR ADVENTURE (North Star and CP/M only) Price: $19.95 Diskette
At last! A comprehensive Adventure game for North Star and CP/M systems. CRANSTON MANOR ADVENTURE takes you into mysterious CRANSTON MANOR where you attempt to gather fabulous treasures. Lurking in the manor are wild animals and robots who will not give up the treasures without a fight. The number of rooms is greater and the associated descriptions are much more elaborate than the current popular series of Adventure programs, making this game the top in its class. Play can be stopped at any time and the status stored on diskette. Not available in 5¼" CP/M format.

GUMBALL RALLY ADVENTURE (North Star only, 48K) Price: $21.95 Diskette
Take part in this outlaw race from the east coast to the west coast. The goal is to find your way to the finish line while maintaining the highest possible speed. You may choose one of five cars available at the garage. The choice will affect your speed and range. Remember to take spare parts and don't get caught speeding!

NEW **UNCLE HARRY'S WILL (North Star only, 40K)** Price: $24.95 Diskette
Uncle Harry has died and has left you everything. However, he has neglected to mention where everything is! Instead, his will consists of a poem which contains clues. You will have to travel all over the United States both by car and on foot to solve the puzzle, and there are over 300 locations to probe. Be careful and watch out for red herrings!

SPEECH SYNTHESIS

DYNACOMP is now distributing the new and revolutionary TYPE-'N-TALK™ (TNT) speech synthesizer from Votrax. Simply connect TNT to your computer's serial interface, enter text from the keyboard and hear the words spoken. TNT is the easiest-to-program speech synthesizer on the market. It uses the least amount of memory and provides the most flexible vocabulary available anywhere!

TYPE-'N'-TALK List price $375. DYNACOMP'S price $319.95 plus $5.00 for shipping and handling.

TALK TO ME (T'N'T Atari only, 24K) Price: $14.95 Cassette/$18.95 Diskette
This program presents a superb tutorial on speech synthesis using the Atari 800 and TYPE 'N TALK™. TALK TO ME will illustrate normal word generation as well as phoneme generation. The documentation includes many helpful programming tips. TALK TO ME has been demonstrated on network (CBS) TV!

MISCELLANEOUS

CRYSTALS (Atari only) Price: $ 9.95 Cassette/$13.95 Diskette
A unique algorithm randomly produces fascinating graphics displays accompanied with tones which vary as the patterns are built. No two patterns are the same, and the combined effect of the sound and graphics are mesmerizing. CRYSTALS has been used in local stores to demonstrate the sound and color features of the Atari. Runs in 16K Atari.

NORTH STAR SOFTWARE EXCHANGE (NSSE) LIBRARY
DYNACOMP now distributes the 23 volume NSSE library. These diskettes each contain many programs and offer an outstanding value for the purchase price. They should be part of every North Star user's collection. Call or write DYNACOMP for details regarding the contents of the NSSE collection.
Price: $9.95 each/$7.95 each (4 or more)
The complete collection may be purchased for $149.95

NEW **5¼" DISKETTES (soft sectored/ten sectored)** Price: $39.95/30 Diskettes
As you might imagine, DYNACOMP purchases diskettes in large quantities and at wholesale prices. We want to pass the savings along to you!

BUSINESS and UTILITIES

NEW **MAILMASTER (Atari diskette only)** — Price: $39.95 Diskette

MAILMASTER is a very versatile software package for managing and manipulating mail lists and mini data bases. Each disk can hold over 600 customer entries containing name, address, 38 letter key words and a phone number. The display is marked so that entries may be made and edited with ease. The status (e.g., disk space left, options, etc.) is shown at all times. Labels may be printed 1,2 or 3 up, and all sorting (zip code and alphabetic) is performed by a fast machine language program.

PERSONAL FINANCE SYSTEM (Atari and North Star only) — Price: $39.95 Diskette

PFS is a single diskette, menu-oriented system composed of ten different programs. Besides recording your expenses and tax deductible items, PFS will sort and summarize expenses by payee, and display information on expenditures by any of 26 user defined codes by month or by payee. PFS will even produce monthly bar graphs of your expenses by category! This powerful package requires only one disk drive, minimal memory (24K Atari, 32K North Star) and will store up to 600 records per disk (and over 1000 records per disk by making a few simple changes to the programs). You can record checks plus cash expenses so that you can finally see where your money goes and eliminate guesswork and tedious hand calculations. Contains high speed machine language sort. PFS has been demonstrated on network (CBS) TV!

FAMILY BUDGET (Apple and Atari only) — Price: $34.95 Diskette

FAMILY BUDGET is a very convenient financial record-keeping program. You will be able to keep track of cash and credit expenditures as well as income on a daily basis. You can record tax deductible items and charitable donations. FAMILY BUDGET also provides a continuous record of all credit transactions. You can make daily cash and charge entries to any of 21 different expense accounts as well as to 5 payroll and tax accounts. Data are easily retrieved giving the user complete control over an otherwise complicated (and unorganized!) subject.

INTELINK (Atari only) — Price: $49.95 Diskette

This software package contains a menu-driven collection of programs for facilitating efficient two-way communications through a full duplex modem (required for use). In one mode of operation you may connect to a data service (e.g., The SOURCE or MicroNet) and quickly load data such as stock quotations onto your diskette for later viewing. This greatly reduces "connect time" and thus the service charge. You may also record the complete contents of a communications session. Additionally, programs written in BASIC, FORTRAN, etc. may be built off-line using the support text editor and later "up-loaded" to another computer, making the Atari a very smart terminal. Even Atari BASIC programs may be uploaded. Further, a command file may be built off-line and used later as controlling input for a time-share system. That is, you can set up your sequence of time-share commands and programs, and the Atari will transmit them as needed; batch processing. All this adds up to saving both connect time and your time.

NEW **PAYFIVE (Apple II plus diskette, two drives required)** — Price: $149.95

This is an enormously flexible employee payroll system with extraordinarily good human engineering features. PAYFIVE prints checks and computes the required federal, state and local forms for up to 148 employees. The pay methods may be hourly, salary, commission or any combination. There are multiple options for pay periods, and they also can be used in any combination. PAYFIVE includes *many* other features and comes extremely well documented with a 200 page manual. The manual may be purchased separately for $30, and that payment later applied to the software purchase.

SHOPPING LIST (Atari only) — Price: $12.95 Cassette/$16.95 Diskette

SHOPPING LIST stores information on items you purchase at the supermarket. Before going shopping, it will remind you of all the things you might need, and then display (or optionally print) your shopping list and the total cost. Adding, deleting, changing and storing data is very easy. Runs with 16K.

TAX OPTIMIZER (North Star only) — Price: $59.95 Diskette

The TAX OPTIMIZER is an easy-to-use, menu oriented software package which provides a convenient means for analyzing various income tax strategies. The program is designed to provide a quick and easy data entry. Income tax is computed by all tax methods (regular, income averaging, maximum and alternate minimum tax). The user may immediately observe the tax effect of critical financial decisions. TAX OPTIMIZER has been thoroughly field tested in CPA offices and comes complete with the current tax tables in its data files. TAX OPTIMIZER is tax deductible!

NEW **UTIL (Apple only, 48K)** — Price: $19.95 Diskette

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NEW **TURNKEY AND MENU (Atari only)** — Price: $17.95 Diskette

TURNKEY is a utility program which allows you to create autoboot/autorun diskettes easily. Simply load and run TURNKEY, load the program diskette to be modified, and answer the questions! The TURNKEY diskette also comes with DOS 2.0 and includes another program, MENU. MENU lists the contents of your diskette alphabetically, and permits the running of any BASIC program on the diskette by typing a single key. TURNKEY and MENU provide you with the ability to run any program on your diskette by simply turning on the computer and pressing a single key.

NEW **STOCKAID (Atari only)** — Price: $29.95 Diskette

STOCKAID provides a powerful set of tools for stock market analysis. With STOCKAID you can display point and figure charts, as well as bar charts with oscillators. You can also examine long term moving averages and on-balance-volume features. STOCKAID allows you to input daily data with a single diskette storage capability of 239 days × 16 stocks. Included are stock dividend and split adjustment capabilities. A very professional package!

NEW **SHAPE MAGICIAN (Apple II, 48K, diskette only)** — Price: $29.95

At last! An utility for painlessly creating graphics shapes for the Apple. Create, edit and save up to 30 shapes which can then be used to develop arcade games or to simply enhance your programs. Add that professional touch!

EDUCATION

HODGE PODGE (Apple only, 48K Applesoft or Integer BASIC) — Price: $14.95 Cassette/$18.95 Diskette

Let HODGE PODGE be your child's teacher. Pressing any key on your Apple will result in a different and intriguing "happening" related to the letter or number of the chosen key. The program's graphics, color and sound are a delight for children from ages 1½ to 7. HODGE PODGE is a non-intimidating teaching device which brings a new dimension to the use of computers in education. See the excellent reviews of this very popular program in INFOWORLD and SOFTALK.

NEW **TEACHERS' AIDE (Atari only)** — Price: $13.95 Cassette/$17.95 Diskette

TEACHERS' AIDE consists of three basic modules contained in one program. The first module provides addition and subtraction exercises of varying levels of difficulty. The second module consists of multiplication problems in which the student may be tested both on the final answer and/or on the subtotal answers in the long hand procedure. Several levels of complexity are provided here as well. The third module consists of division problems; one particularly nice feature of the division module is that the long hand division steps can be displayed along with the remainder in order to clearly demonstrate the procedure by which the remainder is derived. Using TEACHER'S AIDE is not merely a drill, but rather a learning experience.

NEW **PHARMACOLOGY UPDATE (PET only)** — Price: $169.95 Cassette/$149.95 Diskette

This is DYNACOMP's first educational software entry for the medical profession (more are coming!). PHARMACOLOGY UPDATE was written by a R.N. as a masters project, with the aid of a practicing pharmacologist and an electronics instructor. This package comes in two parts. The first part is a 200 page manual which is divided into 11 sections. Each of these sections provides both concise information and probing questions. The second part consists of 11 programs that are keyed to the text and which test the degree of your understanding of the text material. This package has great educational value for the beginning student as well as the professional interested in an efficient way to review and update his or her knowledge. Available on cassettes (11) or diskette.

NEW **TEACHER'S GRADEBOOK (Apple 48K dual/single drive)** — Price $69.95 Diskette

TEACHER'S GRADEBOOK is a *complete* password protected record-keeping system for the classroom. It supports up to nine users, and each user may have data for up to nine classes on one disk (with up to 90 students per class). Typical information which can be entered, edited and processed includes rosters, absences and grades. Summary reports may be displayed (on the screen) or printed in various ways, with automatic weighted averaging and conversion to letter grades. This system has been tested ("goof-proofed") in the class environment and is both well-written and well-documented.

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STATISTICS and ENGINEERING

DIGITAL FILTER (Available for all computers) — Price: $39.95 Cassette/$43.95 Diskette

DIGITAL FILTER is a comprehensive data processing program which permits the user to design his own filter function or choose from a menu of filter forms. In the explicit design mode the shape of the frequency transfer function is specified by directly entering points along the desired filter curve. In the menu mode, ideal low pass, high pass and bandpass filters may be approximated to varying degrees according to the number of points used in the calculation. These filters may optionally also be smoothed with a Hanning function. In addition, multi-stage Butterworth filters may be selected. Features of DIGITAL FILTER include plotting of the data before and after filtering, as well as display of the chosen filter functions. Also included are convenient data storage, retrieval and editing procedures.

DATA SMOOTHER (Not available for Atari) — Price: $19.95 Cassette/$23.95 Diskette

This special data smoothing program may be used to rapidly derive useful information from noisy business and engineering data which are equally spaced. The software features choice in degree and range of fit, as well as smoothed first and second derivative calculation. Also included is automatic plotting of the input data and smoothed results.

FOURIER ANALYZER (Available for all computers) — Price: $19.95 Cassette/$23.95 Diskette

Use this program to examine the frequency spectra of limited duration signals. The program features automatic scaling and plotting of the input data and results. Practical applications include the analysis of complicated patterns in such fields as electronics, communications and business.

TFA (Transfer Function Analyzer) — Price: $19.95 Cassette/$23.95 Diskette

This is a special software package which may be used to evaluate the transfer functions of systems such as hi-fi amplifiers and filters by examining their response to pulsed inputs. TFA is a major modification of FOURIER ANALYZER and contains an engineering-oriented decibel versus log-frequency plot as well as data editing features. Whereas FOURIER ANALYZER is designed for educational and scientific use, TFA is an engineering tool. Available for all computers.

HARMONIC ANALYZER (Available for all computers) — Price: $24.95 Cassette/$28.95 Diskette

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FOURIER ANALYZER, TFA and HARMONIC ANALYZER may be purchased together for a combined price of $51.95 (three cassettes) and $63.95 (three diskettes).

REGRESSION I (Available for all computers) — Price: $19.95 Cassette/$23.95 Diskette

REGRESSION I is a unique and exceptionally versatile one-dimensional least squares "polynomial" curve fitting program. Features include very high accuracy; an automatic degree determination option; an extensive internal library of fitting functions; data editing; automatic data, curve and residual plotting; a statistical analysis (eg: standard deviation, correlation coefficient, etc.) and much more. In addition, new fits may be tried without reentering the data. REGRESSION I is certainly the cornerstone program in any data analysis software library.

REGRESSION II (PARAFIT) (Available for all computers) — Price: $19.95 Cassette/$23.95 Diskette

PARAFIT is designed to handle those cases in which the parameters are imbedded (possibly nonlinearly) in the fitting function. The user simply inserts the functional form, including the parameters (A(1), A(2), etc.) as one or more BASIC statement lines. Data, results and residuals may be manipulated and plotted as with REGRESSION I. Use REGRESSION I for polynomial fitting, and PARAFIT for those complicated functions.

MULTILINEAR REGRESSION (MLR) (Available for all computers) — Price: $24.95 Cassette/$28.95 Diskette

MLR is a professional software package for analyzing data sets containing two or more linearly independent variables. Besides performing the basic regression calculation, this program also provides easy to use data entry, storage, retrieval and editing functions. In addition, the user may interrogate the solution by supplying values for the independent variables. The number of variables and data size is limited only by the available memory.

REGRESSION I, II and MULTILINEAR REGRESSION may be purchased together for $51.95 (three cassettes) or $63.95 (three diskettes).

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In the past the ANOVA (analysis of variance) procedure has been limited to the large mainframe computers. Now DYNACOMP has brought the power of this method to small systems. For those conversant with ANOVA, the DYNACOMP software package includes the 1-way, 2-way and N-way procedures. Also provided are the Yates 2^{K-P} factorial designs. For those unfamiliar with ANOVA, do not worry. The accompanying documentation was written in a tutorial fashion (by a professor in the subject) and serves as an excellent introduction to the subject. Accompanying ANOVA is a support program for building the data base. Included are several convenient features including data editing, deleting and appending.

BASIC SCIENTIFIC SUBROUTINES, Volumes 1 and 2 (Not available for Atari)

DYNACOMP is the exclusive distributor for the software keyed to the popular texts *BASIC SCIENTIFIC SUBROUTINES, Volumes 1 and 2* by F. Ruckdeschel (see advertisements in BYTE magazine). These subroutines have been assembled according to chapter. Included with each collection is a menu program which selects and demonstrates each subroutine.

Volume 1
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- Collection #3: Chapters 5 and 6 - Random number generators (Poisson, Gaussian, etc.); series approximations.

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- Collection #4: Chapter 4 - CORDIC approximations to trigonometric, hyperbolic, exponential and logarithmic functions.
- Collection #5: Chapter 5 - Table interpolation, differentiation and integration (Newton, LaGrange, splines).
- Collection #6: Chapter 6 - Methods for finding the real roots of functions.
- Collection #7: Chapter 7 - Methods for finding the complex roots of functions.
- Collection #8: Chapter 8 - Optimization by steepest descent.

Price per collection: $14.95 Cassette/$18.95 Diskette

All eight collections are available for $99.95 (eight cassettes) and $129.95 (eight diskettes).

Because the texts are a vital part of the documentation, *BASIC SCIENTIFIC SUBROUTINES, Volumes 1 and 2* are available from DYNACOMP:

BASIC SCIENTIFIC SUBROUTINES, Vol 1 (319 pages): $19.95 + 75¢ postage
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See reviews in KILOBAUD and Dr. Dobbs.

NEW **SOFTNET (Apple II, 48K, diskette only)** — Price $129.95

SOFTNET may be used to create models of liquid pipeline systems to evaluate their flow performance. Up to 150 nodes with up to 150 connecting elements may be simulated, and models may be combined to form yet larger models. If you are involved in water distribution systems, chemical fluid flow problems, building plumbing, or similar situations, this is an ideal analysis tool.

NEW **MATCHNET (TRS-80 only)** — Price: $19.95 Cassette/$23.95 Diskette

It often takes days to iteratively optimize an L, Pi or T matching network for a particular application. Take a few minutes with MATCHNET and you will have the Q, frequency response and reflection coefficients for any of twelve matching networks. You input the source and load impedance and MATCHNET calculates the R, C, (and L) values and plots (and/or prints) the frequency response and reflection coefficients for each configuration. The reviewer of this program remembers when he use to do this by hand and loves MATCHNET!

ACTIVE CIRCUIT ANALYSIS (ACAP) (48K Apple only) — Price: $25.95 Cassette/$29.95 Diskette

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LOGIC SIMULATOR (Apple only; 48K RAM) — Price: $24.95 Cassette/$28.95 Diskette

Test your complicated digital logic design with respect to given set of inputs to determine how well the circuit will operate. The elements which may be simulated include multiple input AND, OR, NOR, EXOR, EXNOR and NAND gates, as well as inverters, J-K and D flip-flops, and one-shots. Inputs may be clocked in with varying clock cycle lengths/displacements and delays may be introduced to probe for glitches and race conditions. A timing diagram for any given set of nodes may be plotted using HIRES graphics. Save your breadboarding until the circuit is checked by LOGIC SIMULATOR.

NEW **NUMBERKRUNCHER (TRS-80 only)** — Price: $69.95 Cassette/$73.95 Diskette

This program is the most complete numerical analysis system available for the TRS-80. It can handle up to 255 data sets, each set having a six character name. It includes complete data editing facilities and convenient data input/output capability. The analyses available are multiple linear regression and correlation determination of residuals, data transformations and extensive graphics generation, including axis naming, and more. The supporting documentation is extremely well written and well organized, and includes appendices which describe the numerical procedures used in the program.

NEW **STATSORT (TRS-80 only)** — Price: $39.95 Cassette/$43.95 Diskette

STATSORT consists of several menu selected programs which allow the user to create (build, edit, merge), format and print files, (machine) sort them on any field, and numerically analyze (maximum, minimum, average, variance, standard deviation) tabulated data. STATSORT is well documented and easy to use. The cassette version can also be employed to create a data type which can be read by the Radio Shack Advanced Statistical Package.

NEW **STATTEST (TRS-80 only)** — Price: $19.95 Cassette/$23.95 Diskette

This is a statistical inference package which helps you make wise decisions in the face of uncertainty. In an interactive fashion you can build and edit data files and test the differences in means, variances and proportions. STATTEST will also perform data analysis as well as do linear correlation and regression. This menu-directed statistical workhorse is rounded out with a chi-square contingency test and a (uniform and normal) random sample generator. The documentation is written by a college professor who guides you through the various tests.

ABOUT DYNACOMP

DYNACOMP is a leading distributor of small system software with sales spanning the world (currently in excess of 50 countries). During the past three years we have greatly enlarged the DYNACOMP product line, but have maintained and improved our high level of quality and customer support. The achievement in quality is apparent from our many repeat customers and the software reviews in such publications as COMPUTRONICS, 80 Software Critique, A.N.A.L.O.G., Softalk, Creative Computing and Kilobaud. DYNACOMP software has also been chosen for demonstration on network television. Our customer support is as close as your phone. It is always friendly. The staff is highly trained and always willing to discuss products or give advice.

CIRCLE 159 ON READER SERVICE CARD

Underlining for Apple Writer

John E. Stith

Apple Writer is a versatile, general-purpose text processor for the Apple II. With the addition of on-screen, lower-case display, (see "Lower-Case Display for *Apple Writer*," *Creative Computing*, Feb. 1981), it offers most of the features required for rapid, convenient text manipulation. The one feature I most wanted, and had not yet found in *Apple Writer*, was underlining.

This article describes the program I wrote to add the underlining capability to *Apple Writer* and to fix an existing right-justification error which I noticed while testing the program. The two modifications are independent, so you can make one or both changes.

Approach

Underlining is admittedly a low-priority feature when compared to abilities such as margin justification. The fact that this was my highest-priority addition is an indication of the completeness of *Apple Writer*. Underlining in typewritten documents is useful for emphasis. The main requirement for underlining in typescripts is to tell the typesetter to use italics, *like this*.

The method required for underlining on a printer varies by type of printer. The main limitation of this program is that it is tailored to the Epson MX-80 printer. The program is still useful for other printers because it provides the entry points and information required for someone else to tailor that small portion of the program without having to pry into the *Apple Writer* program. (Apple Computer, Inc. does not provide the source code.)

The main requirement for underlining in typescripts is to tell the typesetter to use italics.

There are two obvious ways to command a printer to underline. First, every character to be underlined can be followed with a backspace and an underline character. Second, at the end of a normal line, the computer can send a carriage return, suppress the line feed, and send another line consisting solely of blanks and underlines. *Neither* of these alternatives works with the Apple MX-80 controller. The first method doesn't work because the printer can't respond to backspaces. The second doesn't work because the controller always performs a linefeed after a carriage return.

Fortunately, there are two less-obvious ways to tell the MX-80 to underline. First, the computer can send a regular line followed by as many blanks as it takes to fill the MX-80 print buffer (nominally 80). The printer then performs an *automatic* carriage return *without* linefeed and is ready to print the underline buffer which follows. (Switch 1-3 in the MX-80 must be on for this to happen—that is the factory default setting.)

The second way is to manipulate the distance a linefeed moves the paper. By setting the linefeed distance to 1/72", a second line of underlines can be printed very close to the original line. Moving the next line feed 11/72" and then restoring the default of 1/6" resumes normal operation.

I chose the first approach (buffer overflow) because the linefeed adjustments effectively change the top-of-form position. (The MX-80 counts carriage returns, not distance.)

John E. Stith, P.O. Box 7463, Colorado Springs, CO 80933.

```
This is a sample of text, as it would ap
pear while using the Apple Writer text e
ditor, with one <underlined> word.  <Thi
s second sentence is all underlined.>
```

Figure 1. Example of underline control characters while editing.

This is a sample of text, as it would appear while using the Apple Writer text formatter, with one underlined word. This second sentence is all underlined.

Figure 2. Example of underline printout after formatting.

The underlining capability is implemented by adding characters to the text.

Implementation

The underlining capability is implemented by adding characters to the text. Two characters control the current underlining status: the less-than character and the greater-than character. You can modify the characters used, but you should pick ones you seldom use. The less-than character turns on underlining; the greater-than character turns it off.

When underlining is active, all non-blank characters in the body of the text are underlined. Characters in the page header will not be underlined.

Figures 1 and 2 show before and after examples of how the characters are used.

An offshoot of these modifications may be useful to people who need to send embedded control characters to their printers. In the lower-case version described in my February 1981 article, and in this new version, control characters (e.g. Escape) found in the text buffer will be sent correctly.

Getting these characters into the buffer requires some effort, however. One way is first to prepare a small, canned message with the editor. Then go into the Apple monitor and use it to modify locations in the text buffer to be the desired control characters (with the most significant bits set on). Finally, use the editor to save that message to disk. Then, at any time, do a control-I insert of the canned message into a larger text file.

Modifications

Figure 3, Source Program for Modifications, shows the program which performs the underlining and corrects the right-justification error. All the changes are applied to the *Apple Writer* PRINTER program. Figure 3 is divided into two general areas: changes and additions.

All lines between the DSECT and DEND lines are changes to existing code. The remainder of the program is a series of subroutines which are called as appropriate. All of the additions fit between addresses $139D and $1544. This area is normally used for an undocumented capability of using the built-in game interface for the printer communications. I don't know whether it works or not, but since most people don't know about it, the feature probably isn't widely used. (That section of the program was enabled by typing "SERIAL" in response to the initial prompt.)

The subroutine PATCH corrects the right-justification error which causes partial and full lines not to match up evenly. The reason they don't is that the original program counts the trailing carriage return as a character for which to leave space. PATCH also corrects a second problem which is annoying for owners of low-speed printers; blank lines in the center and right-justified modes cause half or full lines of blanks, respectively, to be printed. Adding this subroutine and its corresponding JMP corrects the error.

The underline changes which follow all depend on having the lower-case modifications performed. The error correction above is independent of the lower-case modifications and the underline modifications.

ULINIT establishes initial values for critical parameters.

ULMOVE intercepts each character moved to the PRINTER output buffer. If a character is to be underlined, ULMOVE turns off the characters most significant bit (MSB)of the character. ULMOVE also removes the underline start and stop characters from the output buffer so they are not printed.

ULPRCR is executed just after a print line has been transmitted, but before the carriage return has been sent. It sends enough blanks to fill the print buffer of the MX-80 and therefore causes an automatic print without linefeed. Then it transmits the underline buffer, a buffer loaded with blanks and underline characters as appropriate. ULPRCR is the subroutine which must be tailored for other printers.

Figure 3. Source Program for Modification.

```
                    1 ******************************************************
0000:               2 ;UNDERLINING PROGRAM FOR
0000:               3 ;FOR APPLE WRITER
0000:               4 ;TEDITOR PROGRAM
0000:               5 ;AND EPSON MX-80 PRINTER
                    6 ******************************************************
0000:               7 ;DATE: 4 APRIL 1981
0000:               8 ;AUTHOR: JOHN E. STITH
                    9 ******************************************************
0000:              10 ;
0000:              11 ;
                   12 ******************************************************
0000:              13 ;EXTERNALS AND EQUATES
                   14 ******************************************************
0000:              15 ;APPLE MONITOR ENTRY POINT
FDED:              16 COUT     EQU  $FDED      ;OUTPUT CHARAC
0000:              17 ;
0000:              18 ;
0000:              19 ;APPLE WRITER PRINTER ENTRY POINTS
0A37:              20 PRTINI   EQU  $0A37      ;INIT CODE
0F75:              21 PRMOVE   EQU  $0F75      ;MOVE TEXT
1162:              22 PRCONT   EQU  $1162      ;CONTINUE AFTER JUSTIFICATION
12FB:              23 PRTCNV   EQU  $12FB      ;CONVERT OUTPUT
0000:              24 ;
0000:              25 ;
0000:              26 ;APPLE WRITER DATA LOCATIONS
0011:              27 PRCCNT   EQU  $0011      ;CHARACTER COUNT
0014:              28 PRPTR    EQU  $0014      ;BUFFER POINTER
0062:              29 PRWIDE   EQU  $0062      ;LINE WIDTH
9B00:              30 TXBUFF   EQU  $9B00      ;PRINT BUFFER
0000:              31 ;
0000:              32 ;
0000:              33 ;EQUATES
00A0:              34 BLANK    EQU  $A0
00BD:              35 CR       EQU  $8D        ;RETURN
00DF:              36 UL       EQU  $DF        ;UNDERLINE
                   37 ******************************************************
```

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CIRCLE 205 ON READER SERVICE CARD

Underlining, continued...

```
                    39 ************************************************
0000:               40 ;
0000:               41 ;PATCHES TO APPLE WRITER PRINTER
0000:               42 ;
0000:               43         DSECT
0000:               44 ;
0803:               45         ORG  $0803
0803:4C B2 13       46         JMP  ULINIT     ;INSERT NEW INIT CODE
0806:               47 ;
0F6F:               48         ORG  $0F6F
0F6F:4C C2 13       49         JMP  ULMOVE     ;CHECK FOR UNDERLINED CHARAC
0F72:               50 ;
0FC1:               51         ORG  $0FC1
0FC1:20 F0 13       52         JSR  ULPRCR     ;READY TO PRINT UNDERLINES
0FC4:               53 ;
114E:               54         ORG  $114E
114E:20 29 14       55         JSR  ULBLNK     ;INSERT !LM BLANKS
1151:               56 ;
115F:               57         ORG  $115F
115F:4C 9E 13       58         JMP  PATCH      ;CORRECT !RJ AND !CJ ERRORS
1162:               59 ;
116F:               60         ORG  $116F
116F:20 29 14       61         JSR  ULBLNK     ;INSERT !RJ AND !CJ BLANKS
1172:               62 ;
11B2:               63         ORG  $11B2
11B2:EA             64         NOP             ;PATCH FOR JUSTIFICATION CODE
11B3:EA             65         NOP
11B4:C9 A0          66         CMP  #BLANK
11B6:               67 ;
1215:               68         ORG  $1215
1215:20 FB 12       69         JSR  PRTCNV     ;DISABLE U/L IN HEADERS
1218:               70 ;
12D8:               71         ORG  $12D8
12D8:20 3F 14       72         JSR  ULPRNT     ;PRINT TEXT LINE CHAR
12DB:4C FB 12       73         JMP  PRTCNV     ;NORMAL PROCESSING
12DE:               74 ;
0000:               75         DEND
0000:               76 ;
                    77 ************************************************


                    79 ************************************************
0000:               80 ;
----- NEXT OBJECT FILE NAME IS UNDERLINE REV 13.OBJ0
139D:               81         ORG  $139D
139D:60             82         RTS             ;ELIMINATE "SERIAL" OPTION
139E:               83 ; AND FREE SPACE FROM $139E THROUGH $1544
139E:               84 ;
                    85 ************************************************
139E:               86 ;
139E:               87 ;CORRECT !RJ AND !CJ ERRORS:
139E:               88 ; A. FULL AND PARTIAL LINES DO NOT LINE UP EVENLY
139E:               89 ; B. EMPTY LINES CAUSE MULTIPLE BLANKS TO BE PRINTED
139E:               90 ;
139E:BD 00 9B       91 PATCH    LDA  TXBUFF,X  ;IS A C/R AT THE END?
13A1:C9 8D          92          CMP  #CR
13A3:D0 06          93          BNE  PTCHDN    ;NO - ALL OK
13A5:E0 00          94          CPX  #0        ;IS THE C/R THE ONLY CHARACTER?
13A7:F0 08          95          BEQ  PTCHFN    ;YES - DON'T PRINT THE BLANKS
13A9:C6 11          96          DEC  PRCCNT    ;NO - DON'T SAVE SPACE FOR C/R
13AB:A5 62          97 PTCHDN   LDA  PRWIDE    ;CODE DISPLACED BY JMP
13AD:38             98          SEC
13AE:4C 62 11       99          JMP  PRCONT    ;BACK TO !CJ,!RJ CODE
13B1:60            100 PTCHFN   RTS            ;DON'T FINISH PRINTING BLANKS
13B2:              101 ;
                   102 ************************************************
13B2:              103 ;
13B2:              104 ;INITIALIZATION CODE
13B2:              105 ;
13B2:A9 FF         106 ULINIT   LDA  #$FF      ;NO UNDERLINING
13B4:8D 6E 14      107          STA  ULSTAT    ;    IN PROGRESS
13B7:A9 00         108          LDA  #$00
13B9:8D 6F 14      109          STA  ULLINE    ;NO U/L BFFR READY
13BC:8D 70 14      110          STA  ULCOLM    ;ZERO COLUMN COUNT
13BF:4C 37 0A      111          JMP  PRTINI    ;REGULAR PRINTER INIT
13C2:              112 ;
                   113 ************************************************
```

```
                        115 ************************************************
13C2:                   116 ;
13C2:                   117 ;READY TO INSERT CHARACTER INTO
13C2:                   118 ;PRINTER OUTPUT BUFFER
13C2:                   119 ;TURN OFF THE MSB IF IT'S TO BE UNDERLINED
13C2:                   120 ;AND DO NOT MOVE ULSTRT AND ULDONE CHARACTERS
13C2:                   121 ;(DO NOT STRIP MSB FROM C/R)
13C2:                   122 ;
13C2:EB                 123 ULMOVE  INX
13C3:B1 14              124 ULMV    LDA  (PRPTR),Y
13C5:CD 6B 14           125         CMP  ULSTRT     ;START UNDERLINING?
13C8:F0 14              126         BEQ  ULMV01     ;YES
13CA:CD 6C 14           127         CMP  ULDONE     ;FINISHED UNDERLINING?
13CD:F0 1B              128         BEQ  ULMV02     ;YES
13CF:                   129 ;
13CF:                   130 ;COME HERE FOR NORMAL CHARACTERS
13CF:                   131 ;
13CF:C9 A1              132         CMP  #BLANK+1   ;IS IT PRINTABLE?
13D1:90 03              133         BLT  ULMVDN     ;NO
13D3:2D 6E 14           134         AND  ULSTAT     ;NO - SET U/L STATUS
13D6:9D 00 9B           135 ULMVDN  STA  TXBUFF,X   ;MOVE TO BUFFER
13D9:B1 14              136         LDA  (PRPTR),Y
13DB:4C 75 0F           137         JMP  PRMOVE     ;DONE
13DE:                   138 ;
13DE:                   139 ;
13DE:A9 7F              140 ULMV01  LDA  #$7F       ;START U/L
13E0:8D 6E 14           141         STA  ULSTAT     ;SET STATUS
13E3:C8                 142         INY             ;SKIP MOVE
13E4:4C C3 13           143         JMP  ULMV       ;REPEAT FOR NEXT CHAR
13E7:                   144 ;
13E7:A9 FF              145 ULMV02  LDA  #$FF       ;STOP U/L
13E9:8D 6E 14           146         STA  ULSTAT     ;SET STATUS
13EC:C8                 147         INY             ;SKIP MOVE
13ED:4C C3 13           148         JMP  ULMV       ;REPEAT FOR NEXT CHAR
13F0:                   149 ;
                        150 ************************************************

                        152 ************************************************
13F0:                   153 ;
13F0:                   154 ;READY TO PRINT LINE OF TEXT
13F0:                   155 ;(ALL CHARACTERS EXCEPT C/R HAVE BEEN SENT)
13F0:                   156 ;
13F0:AD 6F 14           157 ULPRCR  LDA  ULLINE     ;U/L'S TO PRINT?
13F3:F0 28              158         BEQ  ULPRDN     ;NO
13F5:                   159 ;
13F5:                   160 ;NEED TO SEND FULL ULCLMX CHARACTERS
13F5:                   161 ;TO CAUSE A PRINT ON BUFFER FULL
13F5:                   162 ;AND THEN SEND THE UNDERLINE BUFFER
13F5:                   163 ;
13F5:AE 70 14           164         LDX  ULCOLM     ;GET COUNT OF CHARACTERS SENT
13F8:A9 A0              165 ULPR01  LDA  #BLANK     ;SEND BLANKS UNTIL ULCLMX
13FA:EC 6D 14           166         CPX  ULCLMX     ;FULL LINE SENT?
13FD:B0 07              167         BGE  ULPR02     ;YES
13FF:E8                 168         INX             ;NO
1400:20 ED FD           169         JSR  COUT
1403:4C F8 13           170         JMP  ULPR01     ;CONTINUE
1406:                   171 ;
1406:                   172 ;MAX CHARACTERS HAVE NOW BEEN SENT
1406:                   173 ;AND AN AUTOMATIC C/R SHOULD HAVE OCCURRED.
1406:                   174 ;NOW TRANSMIT THE U/L BUFFER (BLANKS AND U/L'S)
1406:                   175 ;
1406:A2 00              176 ULPR02  LDX  #$00
1408:BD 72 14           177 ULPR03  LDA  ULBUFF,X
140B:8E 71 14           178         STX  ULSAVE     ;SAVE X REG
140E:20 FB 12           179         JSR  PRTCNV     ;CONVERT CHARACTER
1411:AE 71 14           180         LDX  ULSAVE     ;RESTORE X
1414:20 ED FD           181         JSR  COUT       ;SEND CHARACTER
1417:E8                 182         INX
1418:EC 70 14           183         CPX  ULCOLM     ;DONE?
141B:90 EB              184         BLT  ULPR03     ;NO
141D:                   185 ;
141D:A9 00              186 ULPRDN  LDA  #$00       ;RESET INDICATORS
141F:8D 6F 14           187         STA  ULLINE
1422:8D 70 14           188         STA  ULCOLM
1425:B9 00 9B           189         LDA  TXBUFF,Y
1428:60                 190         RTS             ;DONE
1429:                   191 ;
                        192 ************************************************
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CIRCLE 161 ON READER SERVICE CARD

Underlining, continued...

```
                        194 ************************************************
1429:                   195 ;PUT BLANKS IN U/L BUFFER
1429:                   196 ; A REG = $A0 ON ENTRY
1429:8D 71 14           197 ULBLNK  STA  ULSAVE     ;SAVE A REG
142C:8A                 198         TXA             ;SAVE X REG
142D:48                 199         PHA
142E:20 5F 14           200         JSR  ULNEXT     ;SET X TO COLUMN
1431:A9 A0              201         LDA  #BLANK
1433:9D 72 14           202         STA  ULBUFF,X   ;PUT BLANK IN U/L BUFFER
1436:68                 203         PLA             ;RESTORE X
1437:AA                 204         TAX
1438:AD 71 14           205         LDA  ULSAVE     ;RESTORE A
143B:20 ED FD           206         JSR  COUT       ;SEND CHARACTER
143E:60                 207         RTS
                        208 ************************************************
143F:                   209 ;HANDLE PRINTABLE CHARACTERS
143F:                   210 ;IN BODY OF TEXT
143F:                   211 ;(PUT BLANKS OR U/L INTO U/L BUFFER)
143F:8D 71 14           212 ULPRNT  STA  ULSAVE     ;SAVE A REG
1442:20 5F 14           213         JSR  ULNEXT     ;SET X TO COLUMN
1445:C9 80              214         CMP  #$80       ;U/L CHARACTER?
1447:90 08              215         BLT  ULPRUL     ;YES
1449:A9 A0              216         LDA  #BLANK     ;PUT BLANK IN BUFFER
144B:9D 72 14           217         STA  ULBUFF,X
144E:4C 5B 14           218         JMP  ULTERM
1451:                   219 ;
1451:                   220 ;U/L CHARACTER TO BUFFER
1451:A9 DF              221 ULPRUL  LDA  #UL
1453:9D 72 14           222         STA  ULBUFF,X
1456:A9 01              223         LDA  #$01       ;SET FLAG TO PRINT LATER
1458:8D 6F 14           224         STA  ULLINE
145B:                   225 ;
145B:AD 71 14           226 ULTERM  LDA  ULSAVE     ;RESTORE A REG
145E:60                 227         RTS             ;DONE
                        228 ************************************************
145F:                   229 ;INTERNAL SUBROUTINE TO BUMP COLUMN NUMBER
145F:                   230 ;  WITHIN LIMITS
145F:AE 70 14           231 ULNEXT  LDX  ULCOLM     ;POINT TO COLUMN
1462:EC 6D 14           232         CPX  ULCLMX     ;TOO HIGH?
1465:B0 03              233         BGE  ULNX       ;YES
1467:EE 70 14           234         INC  ULCOLM     ;NO, BUMP IT
146A:60                 235 ULNX    RTS             ;DONE
                        236 ************************************************



                        238 ************************************************
146B:                   239 ;
146B:                   240 ;LOCAL DATA AREA FOR PATCHES
146B:                   241 ;
146B:BC                 242 ULSTRT  ASC  '<'        ;START U/L CHARACTER
146C:BE                 243 ULDONE  ASC  '>'        ;END U/L CHARACTER
146D:                   244 ;     THE TWO ABOVE CHARACTERS CAN BE ANY
146D:                   245 ;LEGAL ASCII CHARACTERS WITH THE
146D:                   246 ;MOST SIGNIFICANT BIT (MSB) SET ON
146D:                   247 ;BUT CHOOSE TWO THAT AREN'T USED REGULARLY
146D:                   248 ;
146D:50                 249 ULCLMX  DFB  80         ;MAX COLUMNS (40, 66, 80, OR 132)
146E:                   250 ;
146E:FF                 251 ULSTAT  DFB  $FF        ;U/L STATUS - DEFAULT
146F:                   252 ;       FF=NO ACTION
146F:                   253 ;       7F=SET MSB OFF
146F:                   254 ;       ULSTAT IS ANDED WITH MOVED CHARACTERS
146F:                   255 ;       CHARACTERS WITH MSB OFF
146F:                   256 ;       WILL LATER BE UNDERLINED
146F:                   257 ;
146F:00                 258 ULLINE  DFB  $00        ;U/L LINE CONTENTS
1470:                   259 ;       00=NO ACTION
1470:                   260 ;       01=PRINT LINE WHEN READY
1470:                   261 ;
1470:00                 262 ULCOLM  DFB  $00        ;COLUMN NO (RANGE 0-131)
1471:00                 263 ULSAVE  DFB  $00        ;SAVE AREA
1472:                   264 ULBUFF  DS   132        ;BUFFER FOR U/L CHARACTERS
14F6:                   265 ;THE INITIAL CONTENTS OF ULBUFF ARE ARBITRARY
14F6:                   266 ;
14F6:                   267 ;FROM HERE THROUGH $1544 SHOULD BE
14F6:                   268 ;AVAILABLE FOR EXPANSION
14F6:                   269 ;
                        270 ************************************************
14F6:                   271 ;END OF SOURCE
                        272 ************************************************

*** SUCCESSFUL ASSEMBLY: NO ERRORS
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CIRCLE 119 ON READER SERVICE CARD

Modification Checklist

1. Perform all modifications to the Apple Writer TEDITOR and PRINTER programs, as described in "Lower-Case Display for *Apple Writer*," Figure 5, Modification Checklist. (The changes require a lower-case adapter, such as the Paymar adapter.)
2. Save a copy of the lower-case version of PRINTER.
3. Perform the following steps on a *copy* of the lower-case version of PRINTER.
4. Reboot the system from the working disk copy. (*Apple Writer* runs under DOS 3.2 and DOS 3.3.)
5. In response to the editor menu prompt, type:
   Q
6. Type
   BLOAD PRINTER
7. After PRINTER is loaded, enter the Apple monitor by typing:
   CALL -151
8. Use the monitor to enter all instructions and data shown in Figure 3. To do this, make sure that for every line in the figure having one, two, or three bytes specified between the address on the far left and the source program line number ten columns to the right, you enter that byte at the correct address. Do this step *very* carefully. If you make any errors that are uncorrectable, start over at step 4.
9. To go back to Basic, type:
   3D0G
10. To save the new version to disk, type:
    BSAVE PRINTER, A$803, L$10FB
11. To protect your efforts, type:
    LOCK PRINTER
12. Your working copy is now complete. To try it out, reboot the system using the new copy. Create a text file that includes the start-underlining character and the stop-underlining character (as in Figure 1).
13. Now print the text. Your MX-80 should print underlined words (as in Figure 2).
14. Once you are satisified that your new version is working properly, copy it to a backup disk, using the same procedure as in the Apple Writer manual. Just remember that the "L" field on the BSAVE commands for TEDITOR and PRINTER is now $410FB rather than $1040.

ULBLNK inserts blanks, as required, into the underline buffer. ULBLNK is needed because not all blanks to be printed are sent from the same routine in PRINTER. When the left margin (!1m command) is not zero or when centering or right justification are commanded, blanks are sent from two other routines in PRINTER.

ULPRNT inserts blanks and underline characters into the underline buffer as individual print-line characters are transmitted to the printer.

ULNEXT is an internal subroutine which increments the column number for the next blank or underline character. It also prevents buffer overflow.

The data section includes several user-changeable parameters and the underline buffer. ULSTRT and ULDONE may be replaced with any ASCII printable characters. ULCLMX tells the current print-line length for the MX-80 so the software knows how many blanks to send to cause a print on buffer overflow. This is *not* the difference between the left and right margins.

Limitations

The changes described in this article have a few limitations. First, except for the right-justification correction, the changes described will work only with a copy of the *Apple Writer* Version 1.0 PRINTER program which has been modified for on-screen, lower-case display, per my earlier article. This is because the modified version uses true ASCII.

Second, these changes eliminate the undocumented "SERIAL" option. Third, these changes are tailored for the Epson MX-80 printer and probably won't work with any other printer. The following paragraphs give ground rules for adapting the changes for other printers.

Tailoring for Other Printers

Should you want to use underlining with other printers, almost all of the changes here will be directly applicable. The subroutine ULPRCR will probably be the only one requiring modification. Following is a description of the conditions the new ULPRCR must meet.

Upon entry, ULLINE will be non-zero if any underlines are necessary for the current line. ULCOLM will equal the number of characters sent in the regular line, minus one. ULBUFF will contain ASCII blanks and underline characters in the correct order for the line most recently transmitted.

If your printer will accept backspaces, you can backspace to the start of the line and then print ULBUFF. If your printer can be sent a command to inhibit line feed carriage return, you can do so, send the carriage return, send ULBUFF, and then command the printer back into automatic-linefeed mode. The new ULPRCR must save the Y register and execute the code at ULPRDN when it is finished.

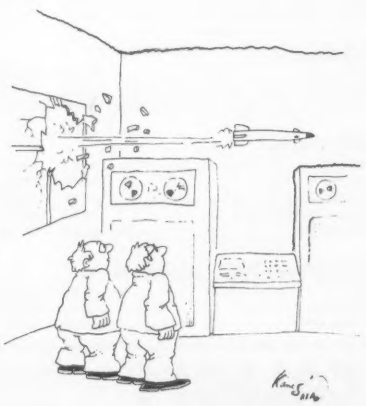
If your printer *always* performs a linefeed following a carriage return and provides no alternatives for backspacing or short line feeds, you probably won't be able to do underlining at all—at least it won't be any more convenient than using a pen, or lining up dashes in the next row.

Installation

Figure 4, Modification Checklist, provides a list of steps necessary when performing the modifications. *Do not* make any changes to your original disks. Make the changes only on copies.

Summary

If you follow the steps in Figure 4, you will have a composite, lower-case display, underlining *Apple Writer*. Your right-hand margins will also be correctly justified. □



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CIRCLE 236 ON READER SERVICE CARD

Preview for Apple Writer

John E. Stith

When the *Apple Writer* text processor program was introduced, it lacked a few features which make general purpose text handling even easier. I described the addition of on-screen, lower-case display in my article "Lower-Case Display for Apple Writer" in the February 1981 issue of *Creative Computing*, and an article on adding the underlining capability, is found on page 146 of this issue.

This article describes the addition of one more function: variable-speed, on-screen preview. The program described here allows you to modify your *Apple Writer* to view the formatted text on the monitor screen, without having to print it. The only catch is that you must incorporate the modifications outlined in the other articles.

Approach

It is easy to perform an on-screen preview with *Apple Writer*. By changing the PRINTER constant menu item J, printer address, to $FDF0 instead of your regular printer address, all text will be directed only to the monitor screen. The problem, however, is that the text will be written quite fast, making it nearly impossible to read.

The approach I chose was to modify the section of *Apple Writer* PRINTER that checks to see if the operator typed an ESCAPE, (and therefore wanted to terminate printing.) Slowing down the display gives the operator time to read the text.

Implementation

The preview mode is controlled by characters typed at the keyboard, as shown in Figure 1, Variable-Speed Scroll Commands. ESCAPE works as normal; it terminates printing. Typing a "P" pauses the printing process until a different character is typed. Typing a "V" causes

John E. Stith, P.O. Box 7463, Colorado Springs, CO 80933.

Figure 1. Variable Speed Preview Commands.

Key	Function
Escape	Terminate Printing
P	Pause
V	Variable-Speed Scroll (Speed Set Via Paddle Zero.)
Any Other	Continue Printing At Full Speed

NOTE: Setting the PRINTER CONSTANT J (Printer Address) to $FDF0 will cause output to be directed only to the monitor.

Figure 2. Source Program for Modifications.

```
SOURCE FILE: PREVIEW REV 4
                1 ************************************************
0000:           2 ;PREVIEW PROGRAM FOR
0000:           3 ;FOR APPLE WRITER
0000:           4 ;PRINTER PROGRAM
                5 ************************************************
0000:           6 ;DATE: 1 AUGUST 1981
0000:           7 ;AUTHOR: JOHN E. STITH
                8 ************************************************
0000:           9 ;EXTERNALS AND EQUATES
               10 ************************************************
0000:          11 ;APPLE KEYBOARD LOCATIONS
C000:          12 KBD      EQU  $C000      KEYBOARD DATA
C010:          13 KBDSTRB  EQU  $C010      KEYBOARD STROBE
0000:          14 ;APPLE MONITOR LOCATIONS
FB1E:          15 PREAD    EQU  $FB1E      ;READ PADDLE
FCA8:          16 WAIT     EQU  $FCA8      ;DELAY ROUTINE
0000:          17 ;APPLE WRITER PRINTER ENTRY POINTS
0F3A:          18 PRNTCT   EQU  $0F3A      ;CONTINUE PRINT
0000:          19 ;EQUATES
00D0:          20 CHARP    EQU  $D0        ;"P"
00D6:          21 CHARV    EQU  $D6        ;"V"
0056:          22 DELAY    EQU  86         ;20 MS DELAY VALUE
               23 ************************************************
```

Figure 3. Modification Checklist.

1. Perform all modifications to the *Apple Writer* TEDITOR and PRINTER programs as described in Reference 1, Figure 5, Modification Checklist, and Reference 2, Figure 4, Modification Checklist. (The changes described require a lower-case adapter, such as the Paymar adapter.)
2. Save a copy of the underlining version of PRINTER.
3. Perform the following steps on a *copy* of the underlining version of PRINTER.
4. Reboot the system from the working disk copy. (*Apple Writer* runs under DOS 3.2 and DOS 3.3.)
5. In response to the editor menu prompt, type:
   Q
6. Type
   BLOAD PRINTER
7. After PRINTER is loaded, enter the Apple monitor by typing:
   CALL -151
8. Use the monitor to enter all instructions and data shown in Figure 2. To do this, make sure that for every line in the figure having one, two, or three bytes specified between the address on the far left and the source program line number ten columns to the right, you enter that byte as the correct address. (An example of how to do this is in Figure 5 of Reference 1.) Do this step *very* carefully. If you make any errors that are uncorrectable, start over at step 4.
9. To go back to Basic, type:
   3D0G
10. To save the new version to disk, type:
    BSAVE PRINTER, A$803, L$10FB
11. To protect your efforts, type:
    LOCK PRINTER
12. Once you are satisfied that your new version is working properly, copy it to a backup disk, using the same procedure as in the *Apple Writer* manual. Just remember that the "L" field on the BSAVE commands for TEDITOR and PRINTER is now $10FB rather than $1040.

the program to enter the variable-speed scroll mode. Game paddle zero controls a pause between lines of from zero to approximately five seconds.

Typing any other character will cause the output to resume at full speed. You can go directly from any mode to any other.

Setting the PRINTER constants menu item J, printer address, to $FDF0 will disable output to your printer.

Modifications

Figure 2, Source Program for Modifications, shows the program which performs the variable-speed preview. All the changes are applied to the *Apple Writer* PRINTER program. The speed range can be changed by altering the value of "DELAY."

Installation

Figure 3, Modification Checklist, provides a list of steps necessary when performing the modifications. *Do not* make any changes to your original disks. Make the changes only on copies.

Summary

By following the steps in Figure 3, you will have a composite, lower-case display, underlining, previewing *Apple Writer*. □

```
                    25 ****************************************************
0000:               26 ;PATCHES TO APPLE WRITER PRINTER
----- NEXT OBJECT FILE NAME IS PREVIEW REV 4.OBJ0
1689:               27          ORG  $1689
1689:               28 ;PATCH EXISTING CODE
1689:EA             29          NOP             ;ELIMINATE
168A:EA             30          NOP             ; STROBE
168B:EA             31          NOP             ;  CLEAR
168C:4C F6 14       32          JMP  CHECK      ;SEE IF PAUSE
168F:               33 ;
168F:               34 ;ADDITIONAL CODE FOR PRINTER
----- NEXT OBJECT FILE NAME IS PREVIEW REV 4.OBJ1
14F6:               35          ORG  $14F6
14F6:AD 00 C0       36 CHECK    LDA  KBD        ;GET KBD INPUT
14F9:C9 D0          37          CMP  #CHARP     ;IS IT A "P" ?
14FB:F0 F9          38          BEQ  CHECK      ;YES - WAIT UNTIL NOT
14FD:C9 D6          39          CMP  #CHARV     ;IS IT V?
14FF:D0 18          40          BNE  DONE1      ;NO - EXIT
1501:               41 * DETERMINE PADDLE 0 VALUE
1501:               42 ; FOR VARIABLE SCROLL RATE
1501:A2 00          43          LDX  #0         ;PADDLE NUMBER
1503:20 1E FB       44          JSR  PREAD      ;READ VALUE
1506:8C 1F 15       45          STY  COUNT
1509:               46 ; DELAY APPROPRIATE NO.
1509:AD 1F 15       47 LOOP     LDA  COUNT
150C:F0 0E          48          BEQ  DONE2      ;YES - TERMINATE
150E:CE 1F 15       49          DEC  COUNT
1511:A9 56          50          LDA  #DELAY     ;WAIT
1513:20 A8 FC       51          JSR  WAIT
1516:4C 09 15       52          JMP  LOOP
1519:8D 10 C0       53 DONE1    STA  KBDSTRB    ;CLEAR STROBE
151C:4C 3A 0F       54 DONE2    JMP  PRNTCT     ;KEEP PRINTING
151F:               55 ;
151F:               56 ; DATA VALUE
151F:00             57 COUNT    DFB  $00        ;VARIABLE DELAY
1520:               58 ;
1520:               59 ;FROM HERE THROUGH $1544 SHOULD BE
1520:               60 ;AVAILABLE FOR EXPANSION
                    61 ****************************************************
1520:               62 ;END OF SOURCE
                    63 ****************************************************

*** SUCCESSFUL ASSEMBLY: NO ERRORS
```


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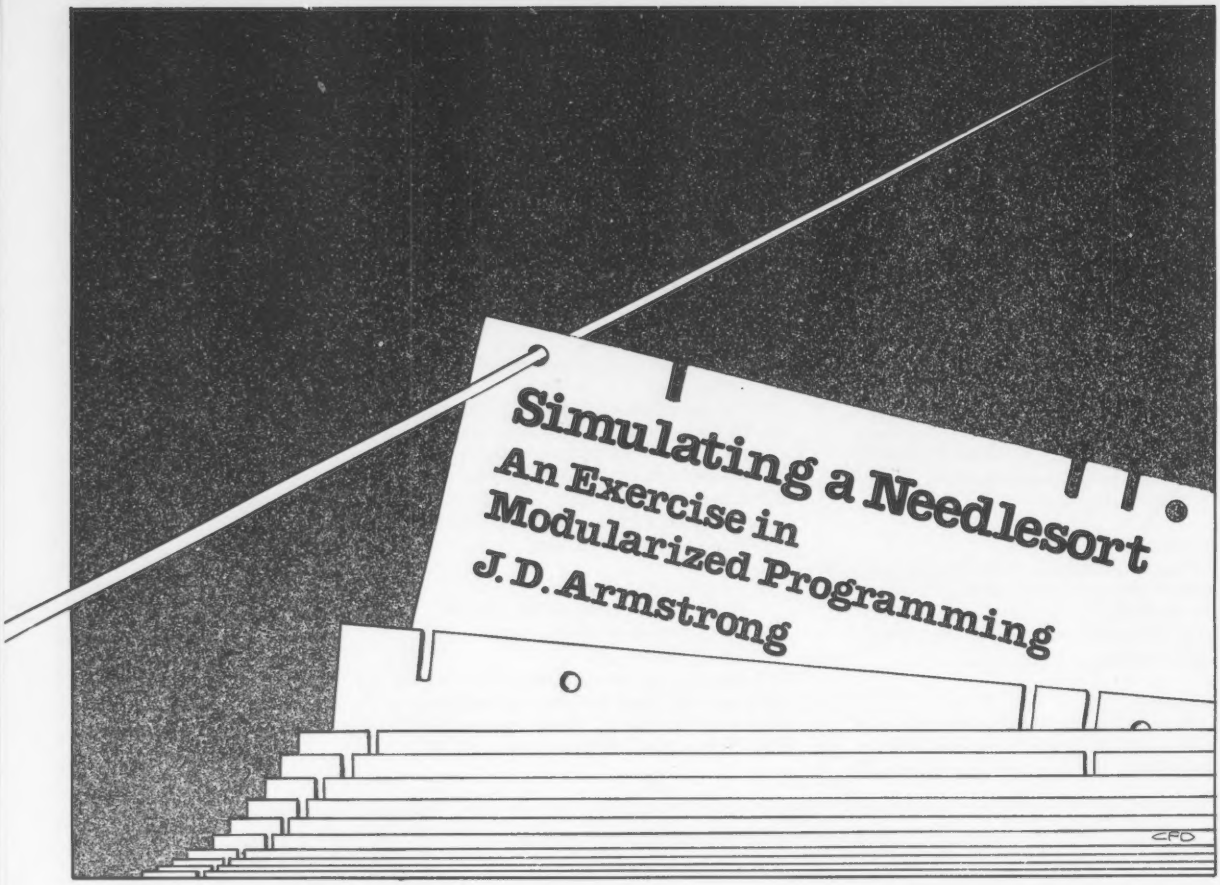
CIRCLE 113 ON READER SERVICE CARD



TESTSRCH was written to test feasibility of a needlesort algorithm. It is also an exercise in modularized programming (a form of structured programming) in Basic. Although written in NorthStar Basic, it can be converted to other Basics.

The Needlesort/Search System

The needlesort system usually uses a large file of cards, each of which has a series of holes prepunched around its perimeter. Each hole has a particular significance in a prearranged code. A notching tool is used to cut a hole to the edge of the card, and a needlelike sorting device is inserted into the stack of cards at the hole location desired and then lifted so that the notched cards drop out.

Several sorters can be inserted at the same time on the same edge for a multi-hole sort. On the other hand, not inserting a sorter needle into a particular hole simply means "don't care" and the card will drop at sort time. This is equivalent to skipping that field when using a computer.

Printed or written data is usually placed on the card to further identify or describe the subject. This system once enjoyed wide use in library and personnel files, and much has been written about the system and the coding techniques used to enhance selections.

J.D. Armstrong, 8035 E. Cole St., Downey, CA 90242.

One of the goals of structured programming is the elimination of the GOTO statement.

An example of an application to which a needlesort system might be applicable is the selection of real estate listings based on computer preferences. Coding of the holes could contain information such as: number of bedrooms, number of baths, number of garages, swimming pool, patio, corner lot, forced air heat, air conditioning, carpets, draperies, 220 volt service, etc. These could all be sorted on a one hole basis. Price information and other quantified data such as size of the lot, and size of the house would probably require more than one hole to provide an adequate search field.

Further, on this type of data, the buyer is usually interested in "less than" a certain price while the salesperson not only desires this but perhaps that price plus 10 percent to add to the possible universe of listings that are selected.

TESTSRCH and its data file TEST-DATA embodies only a skeletal sample of the real estate application but I think it is adequate to demonstrate the computerized needlesort system.

A record is limited to essentially one line (75 bytes) and includes a sort selection on four simple real estate descriptors and price. The text portion was written as a representative brief format of a full blown listing card.

It was with these thoughts in mind that TESTSRCH was written to test the capability of a computer program to simulate this system. Table 1 shows a conceptual comparison of the two systems.

Hardware/Software

The computer system I used is a North-Star Horizon II with 56K of RAM and two double-density disk drives, NorthStar DOS and Release 5.0 NorthStar Basic. Peripherals consist of a SOROC IQ 120 Terminal and a TI 810 printer.

Structured Programming

According to many writers, Basic is not a good language candidate for structured programming. In writing this program I referred to a book titled *Techniques of Program Structure and Design* by Edward Yourdon. I consider it quite lucid and complete.

Building Blocks

There are three basic building blocks and one extension of these blocks that are used in structured design. They are:

The process box. The process box can be as simple as one statement or consist of a group of statements having only one entry and one exit. See Figure 1.1

The generalized loop mechanism. The loop mechanism is usually referred to as the DO-WHILE statement. The FOR-NEXT loop in Basic is one form of this loop that is satisfactory. A DO-WHILE loop can be written but requires the use of a GOTO statement. See Figure 1.2

The binary decision mechanism. This is referred to as the IF-THEN-ELSE statement and NorthStar Basic does support this statement although some care must be used if line numbers are referenced to preserve the one entry/one exit concept. See Figure 1.3

The CASE mechanism. This is called an extension mechanism by Yourdon. It is referred to as the CASE-OF statement. This is supported by Basic with either the ON-GOTO statement or by a series of IF-THEN statements. See Figure 1.4

Yourdon points out that all these mechanisms have but one entry and one exit. All of these in turn may be successively transformed to a single process box. On the other hand, the reverse sequence of these transformations can be used to design a program in top down fashion, i.e., starting with a single process box and expanding it to a complex structure made of the basic mechanisms.

One of the goals of structured programming was the elimination of the GOTO statement. However, with the desire to use structured programming with such languages as Cobol and Fortran a set of rules for its use was formulated. They are roughly as follows:

1. Limit the GOTO statement to internal use within a module or subroutine. The thought here, is to limit the mischief of which the GOTO statement is capable.

2. A GOTO statment shall not branch to a statement outside of the module or subroutine containing the GOTO. This reinforces the idea that no more than one entry and one exit shall exist for each module/subroutine.

3. A GOTO statement may branch to the exit of the module containing the GOTO statement.

4. A GOTO statement may branch to a line with a greater line number.

Table 1. System Comparison.

Needlesort		Computer
Card file		Disk file
Card		Record
Hole		One byte field
Notched hole		(Y)es/(T)rue/1
Unnotched hole		(N)o/(F)alse/0
A number requires several groups of holes		A number requires a field of bytes equal to the length of the number (if a string). Requires five bytes if a non-string.

Figure 1.0. Structure Mechanisms.

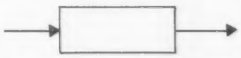


Figure 1.1. The Process Box.

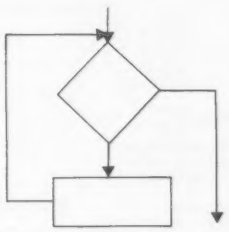


Figure 1.2. The Loop Mechanism.

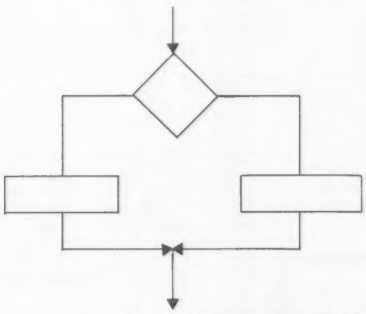


Figure 1.3. The Binary-Decision Mechanism.

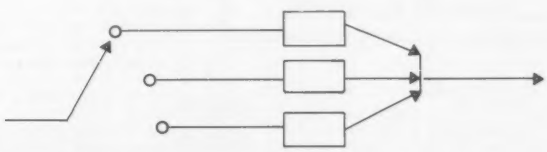


Figure 1.4. The Case Mechanism.

Figure 2.0. Field Assignment for a Record.

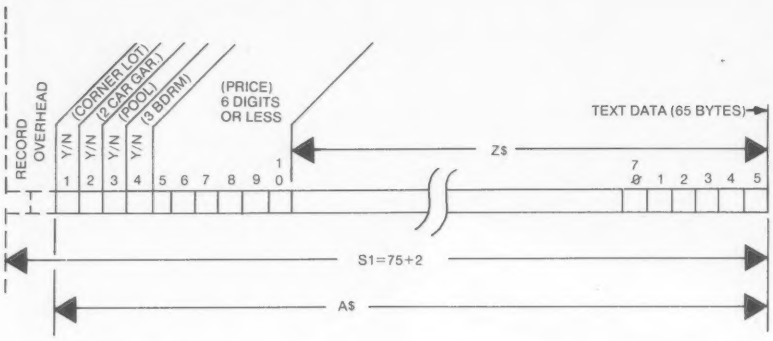
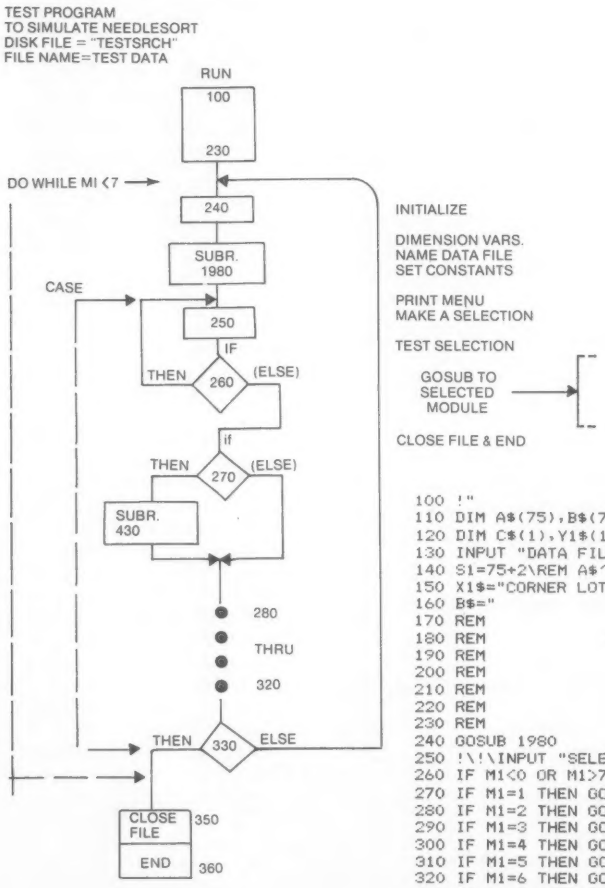


Figure 3.1. Main Program Module.



Implementing a Structured Program

Top down design requires careful thought. It's OK to jot down a few notes and make an assignment of the fields in a record. Figure 2.0 depicts the assignments made for the example program.

The rest of this article describes the steps I followed in writing TESTSRCH.

Step One. Write a descriptive title for the program. This becomes the first process box. In our example:

Test Program
to simulate needlesort
(Program and disk
file name TESTSRCH)
(Data file name TESTDATA)

Step Two. The next series of thoughts should be directed towards the steps/modules/subroutines required to make up the total program. TESTSRCH would require a data base system and use a menu-driven main program to provide the facilities for:

A main program module
Creating records
Updating records
Examining records
Listing records
Deleting a record
.
.
.
Sorting the records
Printing the sort results

Note: The gap in the list is where other requirements can be added later. At this stage we are in an interactive thought process developing the overall structure of the program. This list contains the statements to be pulled out of the first process box and they in turn are process boxes.

Step Three. It is now time to commit these thoughts to paper. I use 11" x 17" sheets held horizontally so that room is

```
100 !"                          ***  TESTSRCH  ***"\!\!\!
110 DIM A$(75),B$(75),Z$(65),K$(10),K1$(10),E$(75),E1$(75)
120 DIM C$(1),Y1$(1),Y2$(1),Y3$(1),Y4$(1),Y5$(6)
130 INPUT "DATA FILE NAME ?",D$\!\!
140 S1=75+2\REM A$'S LENGTH IS 75,+2 FOR OVERHEAD
150 X1$="CORNER LOT "\X2$="2 CAR GAR. "\X3$="POOL "\X4$="3 BDRM "\X5$="PRICE "
160 B$="                                                                    "
170 REM
180 REM              ***MAIN BODY MODULE***
190 REM                              This Module, altho not long,constitutes
200 REM                              the main body of the program. The MENU
210 REM                              SELECT technique is used and is the
220 REM                              backbone of this module.
230 REM
240 GOSUB 1980
250 !\!\INPUT "SELECT MODULE ",M1
260 IF M1<0 OR M1>7 THEN 250
270 IF M1=1 THEN GOSUB 430\REM          ENTER NEW RECORD MODULE
280 IF M1=2 THEN GOSUB 640\REM          UPDATE A RECORD
290 IF M1=3 THEN GOSUB 900\REM          EXAMINE A RECORD
300 IF M1=4 THEN GOSUB 1100\REM         LIST THE RECORDS
310 IF M1=5 THEN GOSUB 1320\REM         DELETE A RECORD
320 IF M1=6 THEN GOSUB 1700\REM         SORT/SEARCH THE RECORDS
330 IF M1=7 THEN 350 ELSE 240\REM       ESCAPE FROM PROGRAM IF SELECTED
340 REM
350 CLOSE#0
360 END\REM          --- END OF MAIN BODY MODULE ---
370 REM
```

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CIRCLE 171 ON READER SERVICE CARD

available for three areas of information: the structured flow diagram, the process statements, and the coding of the module. I title each page with the name of one of the above process boxes, including the first one which is the main program module.

With the statement process box named and placed in the upper left corner, I start a little below the top center of the page and list the things this process box should accomplish in order. A good eraser is just as necessary at this stage as a pencil.

This process of writing statements down stimulates the thought processes and eventually I decide that I have finished the list of statements that make up the module. As progress is made, however, into the other modules I often find that other process boxes should have been listed/deleted. So I add to it and feel no chagrin that I didn't think of it in the first place.

I also remind myself that paper isn't all that expensive; if my work sheet gets so messy that I can't think progressively, I get another sheet and rewrite it in an orderly manner. I place notes to the right of this list that are my thoughts on implementing these statements. These notes may, in some cases, be actual Basic coding statements. I continue this process for all of the modules identified in Step Two.

Step Four. On the right side of the paper I write the code using Basic statements that will implement the structure statements starting with the main program module. DIMension statements will be added as they become known. REM statements are proper to describe the path and substance of the program.

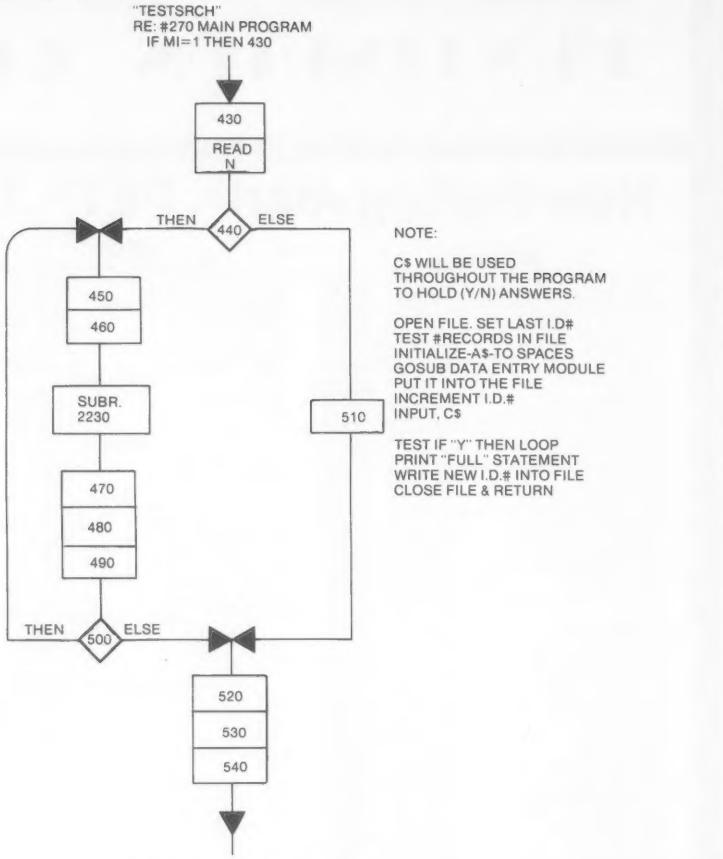
Step Five. In a logical manner, I proceed to code the rest of the subroutines and modules identified in the main program. As each is finished, where practical, it should be exercised and debugged. Each will become a building block upon which the balance of the modules can depend.

Step Six. At this time, or perhaps even before, I make up structure-type flow diagrams. The emphasis is on depicting structure mechanisms and proving them of legal status. I use line numbers in the flow diagram boxes to keep the diagram uncluttered. If a structural problem exists, the diagram should be of assistance. I rearrange, recode and rerun until it becomes clear that I have a valid running module. Another goal to be kept in mind is the minimal use of the GOTO statement and then only as the GOTO rules allow. I continue until all modules are structured and running.

I hope that the above procedures haven't discouraged anyone. The success of coding a well formed program, with good documentation, within the structured regimen is a reward in itself.

Step Seven. I make a listing of each module and place it on the right side of the work sheet. I line up the structured statements with the listing and then add on the structured flow diagram on the far left side of the work sheet. Figures 3.1 to 3.9 were generated using this procedure.

Figure 3.2. New Data Module.




```
380 REM                *** NEW DATA MODULE ***
390 REM                          This Module installs all the new records
400 REM                          to a named file. Random Access files are
410 REM                          used.  It calls the Data Entry Subroutine
420 REM
430 OPEN#0,D$\READ #0,N
440 IF N<150 THEN 450 ELSE 510
450 A$=B$+B$
460 GOSUB 2230
470 WRITE#0%N*S1+5,A$,NOENDMARK
480 N=N+1
490 INPUT "ADD ANOTHER ? ",C$
500 IF C$="Y" THEN 450 ELSE 520
510 !"FILE FULL"
520 WRITE#0%0,N,NOENDMARK
530 CLOSE #0
540 RETURN
550 REM                --- END NEW DATA MODULE ---
560 REM
570 REM
```

Figure 4 is the listing of the records of the TESTDATA file. Each line is equivalent to one record (75 bytes). The first four bytes are the "Y" and "N" descriptors. The next six bytes are reserved for the price field and the balance (65 bytes) is allocated for the text of a foreshortened Real Estate listing.

Figure 5 is an example of a typical prompt and answer session. This printed output from the computer can now be reviewed and checked for accuracy of selection. Remember that the price should be less than or equal to 110% of the price selected.

The test program has served its purpose. We have written it in structured form and it has shown that the basic sort/search algorithm is practical and predictable. With expansion of the number of descriptors and parameters and the addition of input error testing and implementing of a suitable output format a finished Real Estate listings program would result. □

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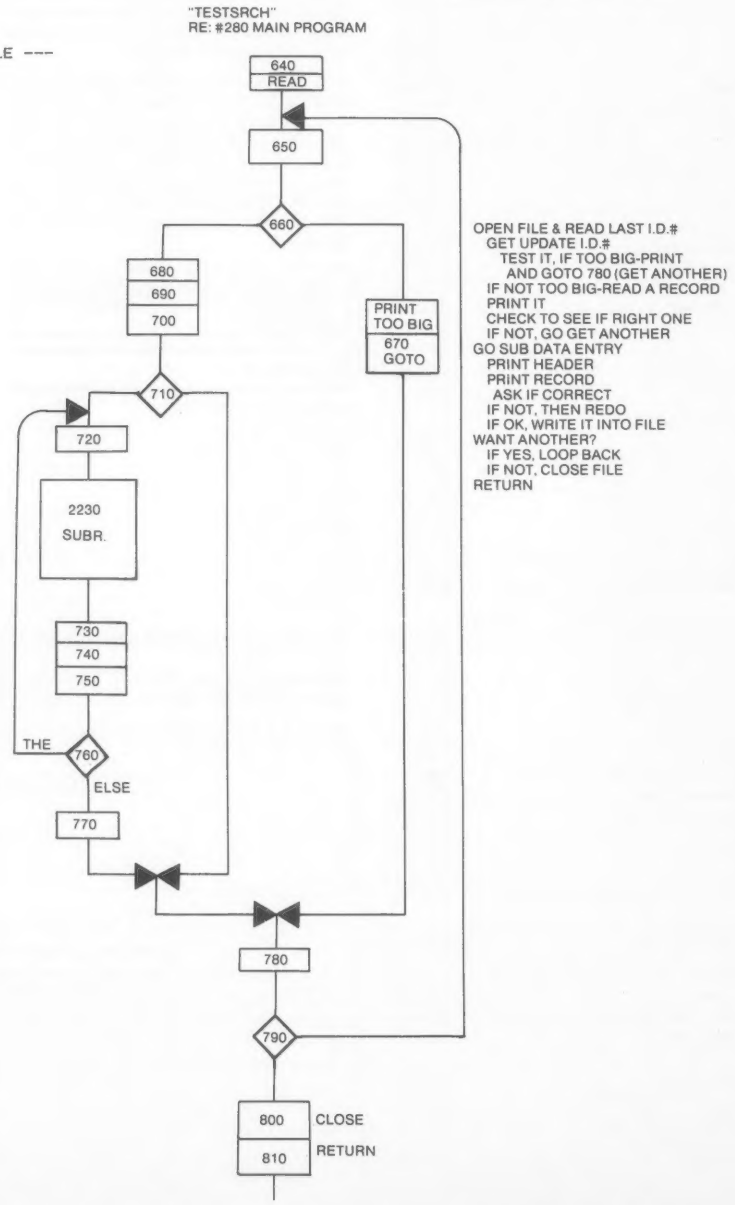
```
580 REM                    *** UPDATE MODULE ***
590 REM                              The UPDATE module provides a facility
600 REM                              to change records on file. Prompting
610 REM                              is used to guide the user. This module
620 REM                              calls DATA ENTRY subroutine.
630 REM
640 OPEN#0,D$\READ #0,N
650 !\INPUT"ID# OF THE RECORD TO BE UPDATED ",J\!
660 IF J>N THEN !"THERE ARE ",N-1,"ENTRIES ON FILE." ELSE 680
670 GOTO 780
680 READ #0%J*S1+5,A$
690 !A$,J
700 INPUT "UPDATE THIS RECORD? ",C$
710 IF C$="N" THEN 780
720 GOSUB 2230
730 !\!"THIS IS THE UPDATED ENTRY. "\!
740 !A$,J
750 INPUT "IS THIS CORRECT? ",C$
760 IF C$="N" THEN 720
770 WRITE#0%J*S1+5,A$,NOENDMARK
780 INPUT "TRY ANOTHER? ",C$
790 IF C$ ="Y" THEN 650
800 CLOSE #0
810 RETURN
820 REM                --- END UPDATE MODULE ---
830 REM
```

Figure 3.3. Update Module.



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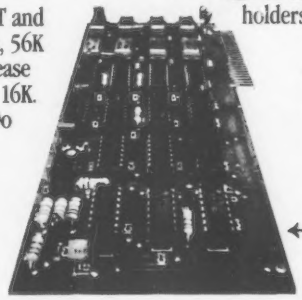

Look, ma, no straps!

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The Manager's first utility, HIDOS,™ will hand you back 10.5K of your Apple's memory space by loading DOS onto a RAM card at boot. HIDOS will automatically load an alternate language onto an available 16K card. And it will amend a copy of your System Master so that the utilities (FID, RENUMBER, etc.) make full use of the extra available memory.

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In short, The Manager makes using memory-expansion cards for your Apple into a simple, no-hassle pleasure. Available at your local dealer or direct for an introductory price of just $34.95.

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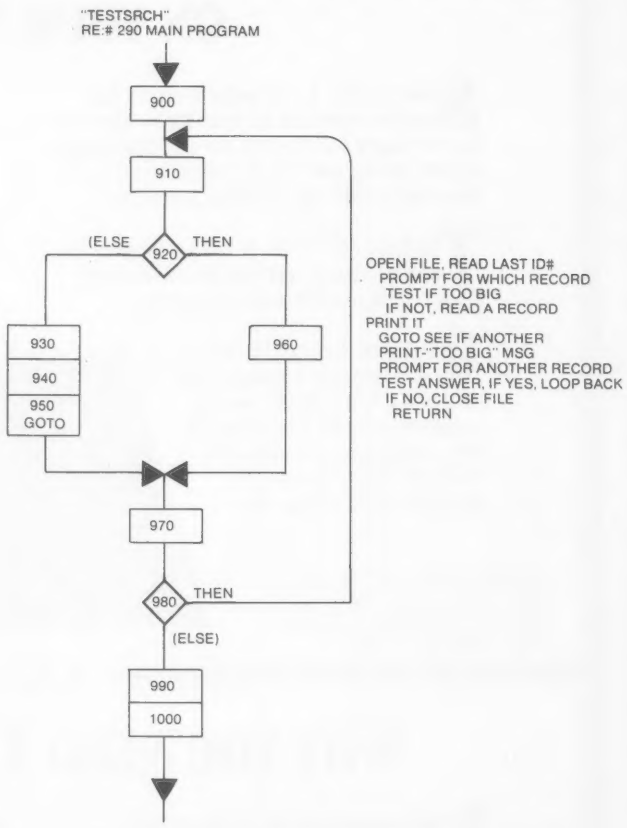
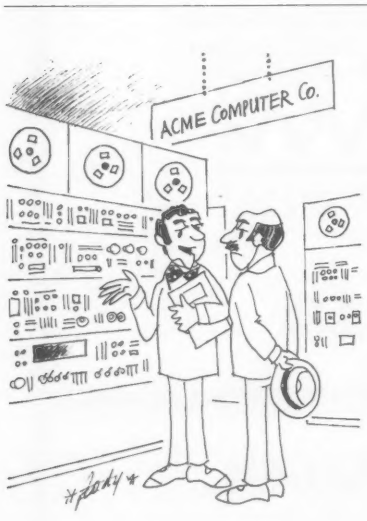
CIRCLE 209 ON READER SERVICE CARD

Needlesort, continued...

```
840 REM              *** EXAMINE MODULE ***
850 REM                        The EXAMINE MODULE allows the user to print
860 REM                        on the terminal a record selected by the ID#.
870 REM                        No changing of the records can be accomplished
880 REM                        By selecting this module.
890 REM
900 OPEN #0,D$\READ #0,N
910 INPUT "EXAMINE WHICH RECORD?(ID #) ",J
920 IF J>N-1 THEN 960
930 READ #0%J*81+5,A$
940 !\!\!A$,J
950 GOTO 970
960 !"THERE ARE",N-1," RECORDS IN FILE."
970 !\!\!\INPUT "EXAMINE ANOTHER RECORD? (Y/N) ",C$
980 IF C$(1,1)="Y" THEN 910
990 CLOSE #0
1000 RETURN
1010 REM              ---END EXAMINE MODULE ---
1020 REM
1030 REM
```

Figure 3.4. Examine Module.





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_____	Double side/double density	$39.90	$_____
_____	Flip/Floppy reversible Double side/double density	$39.90	$_____
_____	Protective plastic library case (in lieu of soft storage box)	$ 2.99	$_____
	Shipping and handling		$ 1.50
	5% sales tax (Mass. only)		$_____
		Total	$_____

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System and model # _____

Name _____

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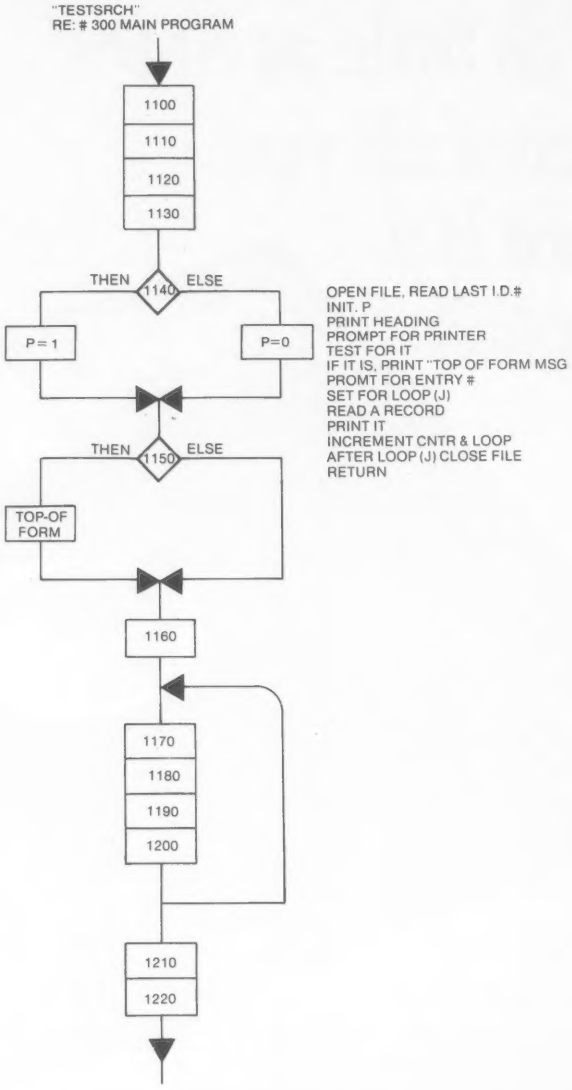
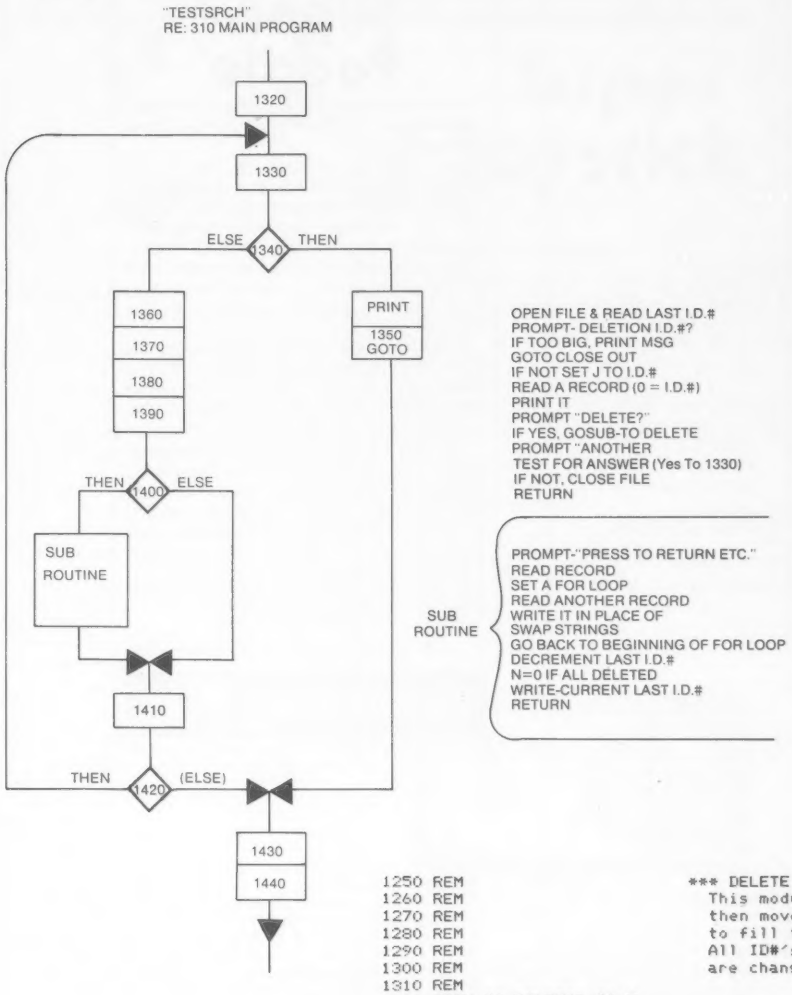
CIRCLE 139 ON READER SERVICE CARD

Figure 3.5. List Module.




```
1040 REM              *** LIST RECORD(S) MODULE ***
1050 REM                      This module prints the records contained in
1060 REM                      the named file on either the terminal or
1070 REM                      printer. The beginning of this printing is
1080 REM                      selectable by ID#.
1090 REM
1100 OPEN #0,D$\READ #0,N
1110 P=0
1120 !TAB(20),"THIS MODULE PRINTS THE FILE"\!
1130 INPUT "PRINTER ON FOR THIS LISTING?(Y/N) ",C$
1140 IF C$="Y" THEN P=1 ELSE P=0
1150 IF P=1 THEN !"SET TOP-OF-FORM"\!
1160 INPUT "START WITH ENTRY NUMBER ",L\!
1170 FOR J=L TO N-1
1180 READ #0%J*S1+5,A$
1190 !#P A$,J
1200 NEXT J
1210 CLOSE #0
1220 RETURN
1230 REM              --- END LIST RECORD(S) MODULE ---
1240 REM
```

Figure 3.6. Delete Module.



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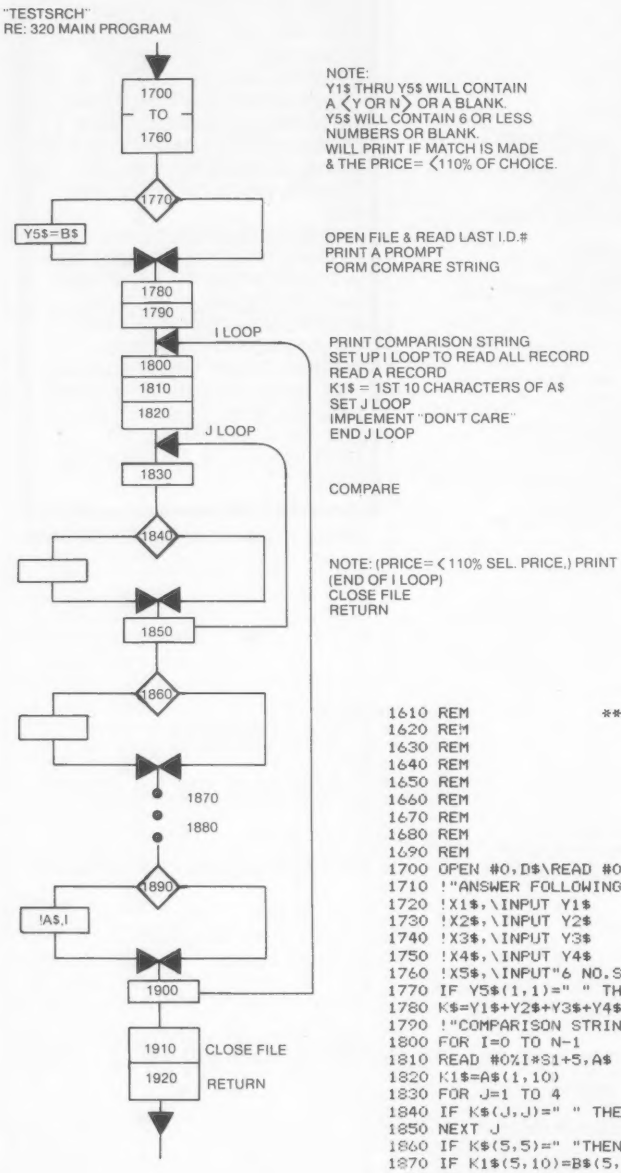
CIRCLE 163 ON READER SERVICE CARD

```
1250 REM                          *** DELETE MODULE ***
1260 REM                            This module deletes a selected record and
1270 REM                            then moves the balance of the records to
1280 REM                            to fill the deleted record.
1290 REM                            All ID#'s from the deleted record to the end
1300 REM                            are changed.Calls a "Deleting Subroutine".
1310 REM
1320 OPEN #0,D$\READ #0,N
1330 INPUT "DELETE WHICH RECORD? ",D\!
1340 IF D>N THEN !"NO SUCH ENTRY, THERE ARE ",N," ENTRIES THIS FILE" ELSE 1360
1350 GOTO 1430
1360 J=D
1370 READ #0%D*S1+5,A$
1380 !A$
1390 INPUT "DELETE THIS ENTRY? (Y/N) ",C$
1400 IF C$="Y" THEN GOSUB 1450
1410 INPUT "DELETE ANOTHER? (Y/N) ",C$
1420 IF C$="Y" THEN 1330
1430 CLOSE #0
1440 RETURN
1450 INPUT "PRESS RETURN TO DELETE ",C$\REM **DELETING SUBROUTINE**
1460 READ #0%(N-1)*S1+5,E1$
1470 FOR J=N-2 TO D STEP -1
1480 READ #0%J*S1+5,E$
1490 WRITE #0%J*S1+5,E1$,NOENDMARK
1500 E1$=E$
1510 NEXT
1520 N=N-1
1530 IF N<0 THEN N=0
1540 WRITE#0%0,N,NOENDMARK
1550 RETURN\REM                                  **END DELETING SUBROUTINE**
1560 REM
1570 REM
1580 REM                  --- END DELETE MODULE ---
1590 REM
1600 REM
```

Figure 3.7. Sort/Search Module.



Super Paddle

Are the paddle controllers on your Apple wearing out? Or did you get a new Apple without paddles?

We've got good news for you! Super Paddles. Each paddle control consists of a high-precision linear potentiometer and a big (1/2" D) industrial-quality pushbutton mounted in a sturdy high-impact molded plastic case which matches the Apple. Each of the two paddles is connected with a long 5 foot cable to the Apple paddle socket.

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To order, send $39.95 plus $2.00 postage and handling to Creative Computing, Dept. C0526, One Park Avenue, Room 458, New York, N.Y. 10016. Orders may also be charged to your Visa, MasterCard or American Express account—by mail include credit card name, number and expiration data, or if you prefer, use our 24 hour toll-free number, 800-631-8112. In NJ only 201-540-0445.

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Peripherals Plus


```
1610 REM              *** SORT/SEARCH MODULE ***
1620 REM                                  This module contains the key ingred-
1630 REM                                  ients of the "Needlesort" system.
1640 REM                                  It builds a comparison string thru
1650 REM                                  a series of prompts. Y1$ thru Y4$
1660 REM                                  expects <Y>es or <N>o answers.
1670 REM                                  Y5$ will accept a 6 digit or less
1680 REM                                  number.
1690 REM
1700 OPEN #0,D$\READ #0,N
1710 !"ANSWER FOLLOWING PROMPTS WITH (Y/N) OR (SPACE-MEANING DON'T CARE)"
1720 !X1$,\INPUT Y1$
1730 !X2$,\INPUT Y2$
1740 !X3$,\INPUT Y3$
1750 !X4$,\INPUT Y4$
1760 !X5$,\INPUT"6 NO.S OR LESS OR SPACE ",Y5$
1770 IF Y5$(1,1)=" " THEN Y5$= B$
1780 K$=Y1$+Y2$+Y3$+Y4$+Y5$+B$
1790 !"COMPARISON STRING K$= ",K$
1800 FOR I=0 TO N-1
1810 READ #0%I*S1+5,A$
1820 K1$=A$(1,10)
1830 FOR J=1 TO 4
1840 IF K$(J,J)=" " THEN K1$(J,J)=" "
1850 NEXT J
1860 IF K$(5,5)=" "THEN K1$(5,10)=B$
1870 IF K1$(5,10)=B$(5,10) THEN 1890
1880 IF VAL(K1$(5,10))<=VAL(K$(5,10))*1.1 THEN K1$(5,10)=K$(5,10)
1890 IF K1$=K$ THEN !A$,I
1900 NEXT I
1910 CLOSE#0
1920 RETURN
1930                  ---END SORT/SEARCH MODULE---
1940 REM
1950 REM
```

Why would anyone spend $59.95 for a joystick?

Super Joystick

Super Joystick

Star Wars. Played with paddles, it's difficult at best and frustrating at worst. But with a joystick, it becomes an entirely new experience. It's still challenging. It's also fun. And very addictive.

Have you ever used a drawing program in which one paddle controls the horizontal movement of the "brush" and the other paddle the vertical? It's slow, tedious work. But with a joystick, drawing is an absolute joy.

Exceptional Precision

The Apple high-resolution screen is divided into a matrix of 160 by 280 pixels. To do precise work on this screen, you need a precise device. Most potentiometers used in paddle controls are not quite linear. If you rotate a paddle control at a constant speed, you'll notice that the cursor speeds up slightly at the beginning and end of the paddle rotation.

The Super Joystick has a pure resistive circuit which is absolutely linear within one tenth of one percent. In other words, it would give you precise control over an image of 1000 by 1000 pixels, were such resolution available. Thus it is suitable for high precision professional applications as well as educational and hobbyist ones.

Matched to your application

The Super Joystick also has two external trim adjustments, one for each direction. This allows you to perfectly match the unit to your application and computer. Say you want to work in a square area instead of the rectangular screen. Just reduce the horizontal size with the trim control.

How many times have you played Space Invasion and had your thumb ache for hours from the repeated button pressing? This won't happen with the Super Joystick. Its two pushbuttons are big. Moreover, they use massive contact surfaces with a life of well over 1,000,000 contacts. A few games of Super Invasion using these big buttons will justify the purchase of the Super Joystick.

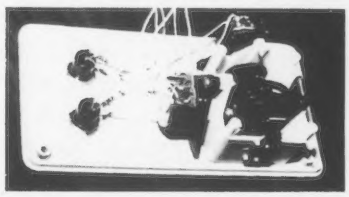
The Super Joystick is self-centering in both directions. That means when you take your hand off it, the control will return to the center. However, if you want it to stay where you leave it, self-centering may be easily disabled by removing two springs.

The Super Joystick plugs right into the paddle control socket and doesn't require an I/O slot.

High-quality construction

The sturdy case of the Super Joystick matches that of the Apple computer. Every component used is the very highest quality available. The Super Joystick even uses a full 16-conductor ribbon cable and you can add a second joystick (using our Select-A-Port extension unit for example) if you wish. The first Super Joystick replaces Paddles 0 and 1. You may not realize it, but the Apple has the capacity to support four paddle controls. A second Super Joystick would replace Paddles 2 and 3.

We invite your comparison of the Super Joystick with any other unit available. Order it and use it for 30 days. If you're not completely satisfied, return it for a prompt and courteous refund plus your return postage. You can't lose.



By removing two springs, self-centering can be defeated.

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E Z Port extends the game I/O port to the outside of your Apple II so that you don't have to open the computer when switching from paddles to joystick, VersaWriter, etc.

E Z Port goes beyond just extending the I/O. We utilize ZIP (Zero Insertion Pressure) sockets. With ZIP sockets, you plug in a 16 pin DIP plug and throw a small switch which engages the connections within the socket. *No stress* is exerted on the 16 pin connector until the switch is thrown.

Ordinary DIP sockets are not designed to be used over and over—eventually they won't make contact. Also repeatedly stressing a 16 pin connector will cause pins to snap off. So, E Z Port will not only *outlast* other I/O extenders, your paddles, VersaWriter and joysticks will last longer too!

Installation is easy: Plug E Z Port's cable into the game I/O, run the 24" cable to the outside of the computer, then peel the protective paper from the special adhesive strip and attach E Z Port to the side of your Apple II. Now making I/O changes will be quick, easy and safe!

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Select A Port

Like the EZ Port, the Select A Port extends the game I/O port to the outside of your Apple II. However, the Select A Port also allows you to permanently plug in up to four peripherals simultaneously. It consists of five switchable I/O ports. The first socket directly parallels the game socket in the Apple. It can be utilized for sensitive devices for which diode isolation would interfere. (There is a switch provided for future expansion and this socket will override the other four). It is mounted in a 6" x 2 3/4" x 1/2" sturdy high impact plastic case. You simply switch on the peripheral to be used (joysticks, paddles, VersaWriter, etc.) and you are ready—no plugging or unplugging of delicate 16 pin connectors. You save wear and tear on your peripherals, your Apple II, and your nerves.

Dual Joysticks

With the Select A Port you can also use two joysticks simultaneously. The Apple II has the capability to read more than just two game controllers (paddles). The second I/O port on the Select A Port is cross wired so that it can be reversed and will read Paddles 2 and 3. Just plug another joystick into any of the remaining three ports and enjoy dual joystick operation. Dual joysticks and no more hassles with connectors. Only $59.95.

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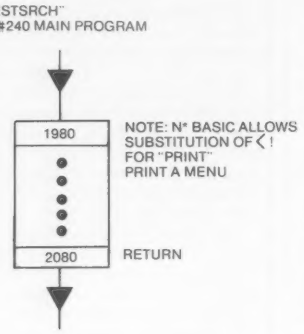
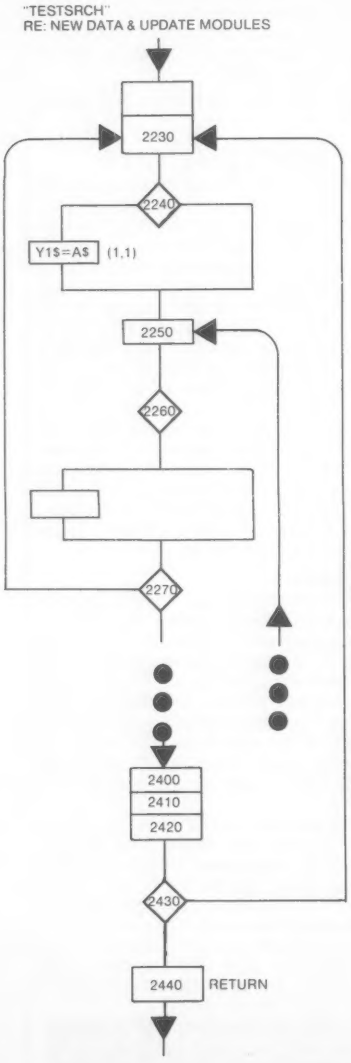
Figure 3.8. Print Menu Module.




```
1960 REM              *** PRINT MENU MODULE ***
1970 REM
1980 !\!\!\!"                              *** MENU ***"
1990 !
2000 !"SELECT BY NUMBER"\!
2010 !"1. ENTER NEW DATA"
2020 !"2. UPDATE A RECORD"
2030 !"3. EXAMINE A RECORD"
2040 !"4. LIST THE RECORDS"
2050 !"5. DELETE A RECORD"
2060 !"6. SORT"
2070 !"7. ESCAPE FROM PROGRAM"
2080 RETURN
2090 REM            --- END PRINT MENU MODULE ---
2100 REM
2110 REM
2120 REM
```

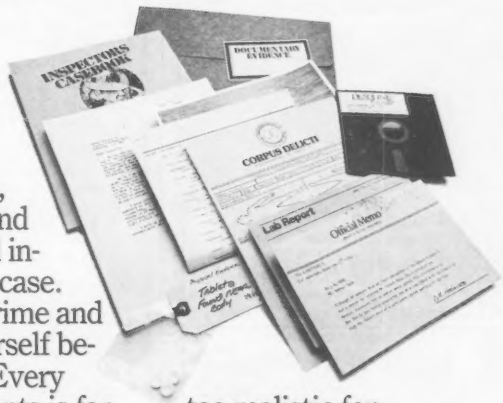
Figure 3.9. Data Entry Module.




```
2130 REM              *** DATA ENTRY SUBROUTINE ***
2140 REM
2150 REM                  This module enters the data.Provision
2160 REM                  is made to change the data of the last
2170 REM                  previous field by entering a < ^ >
2180 REM                  character. During an UPDATE the enter-
2190 REM                  ing of a space character will keep
2200 REM                  whatever data that is presently in
2210 REM                  that field. This Subroutine is called
2220 REM                  by NEW DATA and UPDATE modules.
2230 !X1$,\INPUT "<Y/N>? ",Y1$
2240 IF Y1$=" " THEN Y1$=A$(1,1)\REM A SPACE KEEPS FORMER DATA
2250 !X2$,\INPUT "<Y/N>? ",Y2$
2260 IF Y2$=" " THEN Y2$=A$(2,2)
2270 IF Y2$="^" THEN 2230\REM A <^> RETURNS TO PREVIOUS LINE
2280 !X3$,\INPUT "<Y/N>? ",Y3$
2290 IF Y3$=" " THEN Y3$=A$(3,3)
2300 IF Y3$="^" THEN 2250
2310 !X4$,\INPUT "<Y/N>? ",Y4$
2320 IF Y4$=" " THEN Y4$=A$(4,4)
2330 IF Y4$="^" THEN 2280
2340 !X5$,\INPUT"UP TO 6 NO.S ",Y5$\Y5$=Y5$+B$
2350 IF Y5$(1,1)=" " THEN Y5$=A$(5,10)
2360 IF Y5$="^" THEN 2310
2370 INPUT "LISTING TEXT: ",Z$\Z$=Z$+B$
2380 IF Z$(1,1)=" " THEN Z$=A$(11,75)
2390 IF Z$(1,1)="^" THEN 2340
2400 A$=Y1$+Y2$+Y3$+Y4$+Y5$+Z$+B$
2410 !A$,J
2420 INPUT "IS THIS RECORD OK? (Y/N)",C$
2430 IF C$="N" THEN 2230
2440 RETURN
2450 REM              --- END DATA ENTRY SUBROUTINE ---
```

DEADLINE™

Twelve hours to find the murderer. One false move, and he kills again.



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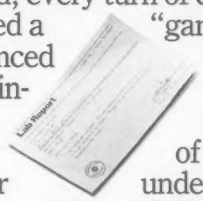

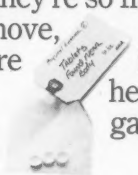

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Needlesort, continued...

Figure. 4. File Test Data.

```
YYYY15000011071 ELM ST LYN. 3 BDRM,POOL,2CAR GAR.,POOL #1000                0
YYYN1000008256 LOCUST DOWNEY,2BDRM,POOL,2 CAR GAR.,CORNER LOT #1001         1
YYNY1250001534 PALM ST NORWALK,3 BDRM,2CAR GAR.,CORNER LOT #XCLUS.          2
YYNN90000 3300 POPLAR AVE. LYN.-2BDRM,2 CAR GAR.,CORNER LOT #1004           3
YNYY94500 12345 SYCAMORE ST DOWNEY-3 BDRM,POOL,1 CAR GAR.,CORNER LOT #1006  4
YNYN80000 3425 CORNISH ST. LYN. 2 BDRM,POOL,1CAR GAR.,CORNER LOT #1010      5
YNNY90000 4040 CANDIST AVE COMP.-3 BDRM,CAR PORT,CORNER LOT  #1011          6
YNNN76000 2525 MULLER ST-BELL-2 BDRM,1 CAR GAR.,CORNER LOT  #1090           7
NYYY86000 1234 HARKER LYN-3 BDRM,POOL,2CAR GAR.,          #2013             8
NYYN73000 4545 MIRIAM LANE-LYN-2 BDRM,POOL,2 CAR GAR.,    #1065             9
NYNY68500 302 LANEY DR DOW.-3 BDRM,2 CAR GAR.,          #1067              10
NYNN45000 4545 GARY COMP.-1 BDRM,2 CAR GAR.,        #2003                  11
NNYY70500 6607 FENWAY ST.,COMP-3 BDRM,POOL,CARPORTS       #1121            12
NNYN1250002235 BERRY DR.-DOW-4 BDRM,POOL,3 CAR GAR       #XCLUS.           13
NNNY60000 5534 BRACKEN AVE.-NOR.-3 BDRM,OPEN PKG,     #2055                14
NNNN30000 2245 BEAN AVE-NOR-2 BDRM,CAR PORT- FIXER UPPER  #5535            15
NNNN150000333 LANEY RD-DOW-5 BDRM,3 CAR GAR. LANDSCAPED   #3303           16
```

Figure 5.

```
                    ***  TESTSRCH  ***


DATA FILE NAME ?TESTDATA

                          *** MENU ***

SELECT BY NUMBER

1. ENTER NEW DATA
2. UPDATE A RECORD
3. EXAMINE A RECORD
4. LIST THE RECORDS
5. DELETE A RECORD
6. SORT
7. ESCAPE FROM PROGRAM

SELECT MODULE 6
ANSWER FOLLOWING PROMPTS WITH (Y/N) OR (SPACE-MEANING DON'T CARE)
CORNER LOT?Y
2 CAR GAR.?Y
POOL ?N
3 BDRM ?Y
PRICE 6 NO.S OR LESS OR SPACE 150000
COMPARISON STRING K$= YYNY150000
YYNY1250001534 PALM ST NORWALK,3 BDRM,2CAR GAR.,CORNER LOT #XCLUS.          2

                          *** MENU ***

SELECT BY NUMBER

1. ENTER NEW DATA
2. UPDATE A RECORD
3. EXAMINE A RECORD
4. LIST THE RECORDS
5. DELETE A RECORD
6. SORT
7. ESCAPE FROM PROGRAM

SELECT MODULE
6
ANSWER FOLLOWING PROMPTS WITH (Y/N) OR (SPACE-MEANING DON'T CARE)
CORNER LOT?
2 CAR GAR.?
POOL ?
3 BDRM ?
PRICE 6 NO.S OR LESS OR SPACE 50000
COMPARISON STRING K$=     50000
NYNN45000 4545 GARY COMP.-1 BDRM,2 CAR GAR.,       #2003                   11
NNNN30000 2245 BEAN AVE-NOR-2 BDRM,CAR PORT- FIXER UPPER  #5535            15

                          *** MENU ***

SELECT BY NUMBER

1. ENTER NEW DATA
2. UPDATE A RECORD
3. EXAMINE A RECORD
4. LIST THE RECORDS
5. DELETE A RECORD
6. SORT
7. ESCAPE FROM PROGRAM

SELECT MODULE 7
READY
```

SD Systems ExpandoRAM III

256K RAM $879.95

Single User System

SBC-200, 64K ExpandoRAM II, Versafloppy II, CP/M 2.2

$1095.00

4 MHz Z-80A CPU, 64K RAM, serial I/O port, parallel I/O port, double-density disk controller, CP/M 2.2 disk and manuals, system monitor, control and diagnostic software.

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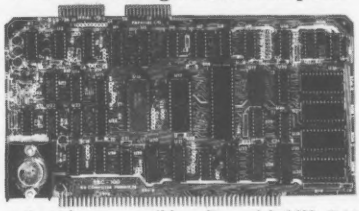
SBC-200

2 or 4 MHz single board computer



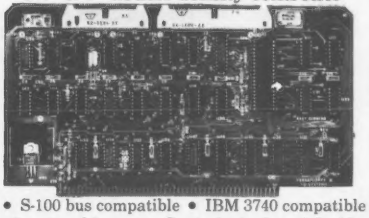
• S-100 bus compatible • Powerful 4MHz Z-80A CPU • Synchronous/asynchronous serial I/O port with RS-232 interface and software programmable baud rates up to 9600 baud • Parallel input and parallel output port • Four channel counter/timer • Four maskable, vectored interrupt inputs and a non-maskable interrupt • 1K of on-board RAM • Up to 32K of on-board ROM • System monitor PROM included

The SBC-200 is an excellent CPU board to base a microcomputer system around. With on-board RAM, ROM, and I/O, the SBC-200 allows you to build a powerful three-board system that has the same features found in most five-board microcomputers. The SBC-200 is compatible with both single-user and multi-user systems.

CPU-30200A *A & T with monitor* **$299.95**

Versafloppy II

5¼" & 8" double density controller



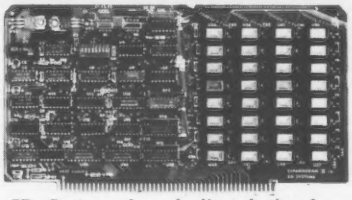
• S-100 bus compatible • IBM 3740 compatible soft sectored format • Controls single and double-sided drives, single or double density, 5¼" and 8" drives in any combination of four simultaneously • Drive select and side select circuitry • Analog phase-locked loop data seperator • Vectored interrupt operation optional • Standard CP/M 2.2 disk operating • Control/diagnostic software PROM included

The Versafloppy II is faster, more stable and more tolerant of bit shift and "jitter" than most controllers. All control and diagnostic software included.

IOD-1160A *A & T* **$359.95**
For CP/M 2.2 and manual set add **$99.95**

ExpandoRAM III

64K to 256K expandable RAM board



SD Systems has duplicated the famous reliability of their ExpandoRAM I and II boards in the new ExpandoRAM III, a board capable of containing 256K of high speed RAM. Utilizing the new 64K x 1 dymanic RAM chips, you can configure a memory of 64K, 128K, 192K, or 256K, all on one S-100 board. Memory address decoding is done by a programmed bipolar ROM so that the memory map may be dip-switch configured to work with either COSMOS/MPM-type systems or with OASIS-type systems.

Extensive application notes concerning how to operate the ExpandoRAM III with Cromemco, Intersystems, and other popular 4 MHz Z-80 systems are contained in the manual.

MEM-65064A *64K A & T* **$495.00**
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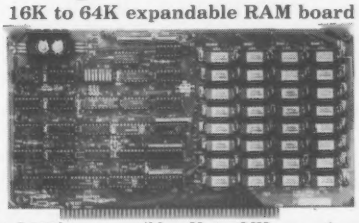
MEM-65192A *192K A & T* **$769.95**
MEM-65256A *256K A & T* **$879.95**

ExpandoRAM II

16K to 64K expandable RAM board



• S-100 bus compatible • Up to 4MHz operation • Expandable from 16K to 64K • Uses 16 x 1 4116 memory chips • Page mode operation allows up to 8 memory boards on the bus • Phantom output disable • Invisible on-board refresh

The ExpandoRAM II is compatible with most S-100 CPUs. When other SD System' series II boards are combined with the ExpandoRAM II, they create a microcomputer system with exceptional capabilities and features.

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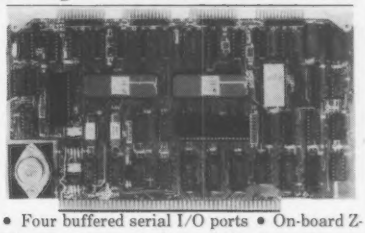
-All boards are assembled and tested-

MPC-4

Intelligent communications interface



• Four buffered serial I/O ports • On-board Z-80A processor • Four CTC channels • Independently programmable baud rates • Vectored interrupt capability • Up to 4K of on-board PROM • Up to 2K of on-board RAM • On-board firmware

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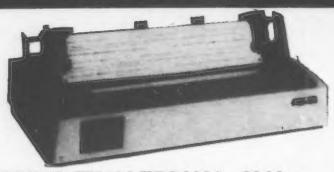

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CIRCLE 177 ON READER SERVICE CARD

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S-100 diagnostic analyzer board, dynamic visual display of all 96 IEEE S-100 signals, aids in real time analysis of faulty hardware and software

TSX-200B *Bare Board* $59.95
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ams...short programs...sho

This elegant program produces geometric designs by selecting 20 random points and connecting them. The end product is suitable for viewing or designing bizarre dungeon dice.

One Line Graphics Demo

David Simons

```
10  DIM X(20),Y(20): HGR2 : HCOLOR= 3: FOR A = 1 TO 20:X =
INT ( RND (1) * 279) + 1:Y =  INT ( RND (1) * 191) + 1:X(A)
= X:Y(A) = Y: FOR B = 1 TO A: HPLOT X,Y TO X(B),Y(B): NEXT B
: FOR W = 1 TO 300: NEXT W,A: FOR W = 1 TO 999: NEXT W: RUN
```

David Simons, 7 Barnsley Rd., Lynnfield, MA 01940.

NUM-WORD

Michael Sorens

Numword is a program which can be used as a module in another program to convert a single precision number to an English phrase of dollars and cents. I use it in a checking program I wrote.

For example, an input of 206 will produce an output of "two hundred six and 00/100 dollars." The program as shown below is written to be stand-alone on a TRS-80 Model I so one can become familiar with it.

```
5000 REM **********  NUMWORD     6/1/80
5005 REM ********** WRITTEN BY MICHAEL SORENS
5010 CLEAR 200:CLS
5020 DIM B$(28):FOR T=2 TO 28:READ B$(T):NEXT
5030 INPUT"ENTER AMOUNT";X
5040 CENTS=INT((X-INT(X))*100+.5):X=INT(X)
5060 IF X THEN GOSUB 5100 :IF CENTS THEN PRINT "AND ";
5070 IF CENTS THEN PRINT USING"##";CENTS;:PRINT "/100 ";
5080 PRINT"DOLLARS"
5090 GOTO 5030
5100 REM RECURSIVE SUBROUTINE TO PRINT NUMBER AS WORDS
5110 DATA TWENTY,THIRTY,FORTY,FIFTY,SIXTY,SEVENTY,EIGHTY,NINETY
5120 DATA ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN,ELEVEN,
     TWELVE,THIRTEEN,FOURTEEN,FIFTEEN,SIXTEEN,SEVENTEEN,EIGHTEEN,NINETEEN
5130 IF X>999 THEN U=X-INT(X/1000)*1000:X=INT(X/1000):GOSUB 5100 :
     PRINT"THOUSAND ";:X=U
5140 IF X>99 THEN V=X:X=INT(X/100):GOSUB 5100 :PRINT"HUNDRED ";:X=V-X*100
5150 IF X>19 THEN PRINT B$(INT(X/10));" ";:X=X-10*INT(X/10)
5160 IF X THEN PRINT B$(X+9);" ";
5170 RETURN
```

Michael Sorens, 1414 Davidson Road, Abington, PA 19001.

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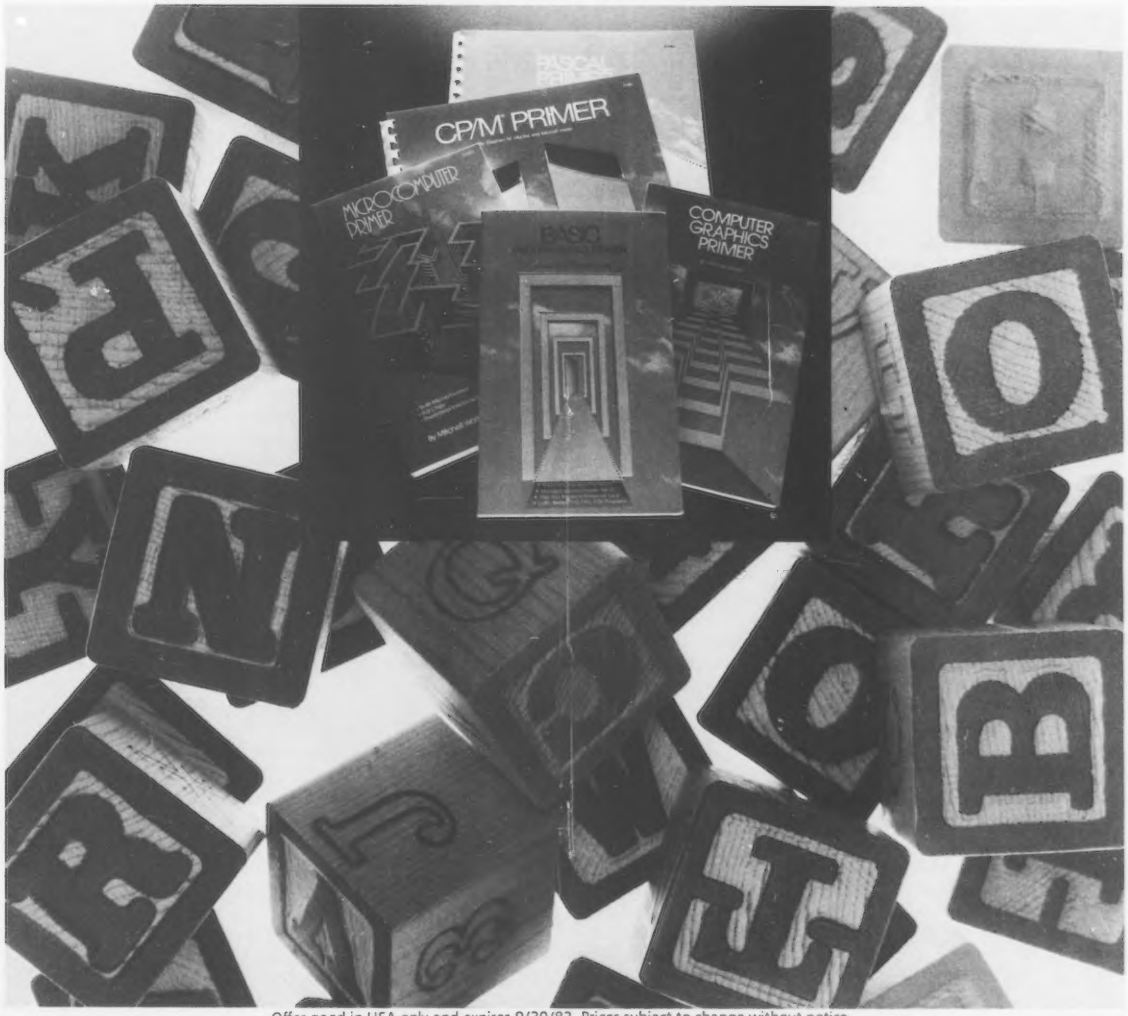

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CIRCLE 168 ON READER SERVICE CARD

A Pseudo Word Processor

Bruno B. Wolff, Jr.

After I had purchased a disk drive and Epson MX-80 printer, I thought, "How nice, now I can use my Apple to take care of my typing needs." It didn't take me long to find out that it was not as easy as it seemed when I first brought the printer home. I couldn't get lower case or do things like save partially done manuscripts.

There was another small problem: I had more or less shot my wad in getting the hardware so I really didn't want to bang down another stack of my hard earned cash right away for a word processor. I decided to write a program that would take me over the interim and let me do my writing and printing in the meanwhile. And so was born the pseudo word processor.

It is something of a disservice to the many good word processors around to dub this program with their generic name—maybe we should have called it a smart typewriter. Nevertheless, it does do a few useful things and really costs little to input and run. You may find it useful for simple correspondence or for uncomplicated reports.

The main menu lists 11 control commands and then asks for input of text. The control characters allow for a variety of options.

Control B lets you reset your tabs.

Control C aborts the session. Use this only for that letter of resignation you write every fifteen months or so since you may lose whatever you have in memory.

Control P issues a paragraph tab, a linefeed and return. The tab is set at the start of the run.

Return sends a return and linefeed. You should use this primarily for inserting blank lines inasmuch as the program automatically does a linefeed after 71 characters. You can keep typing until you run out of memory or decide to end the paragraph.

When you reach the last character in a line, the program looks back for the first space and puts characters after it into the next line. It doesn't clear the moved characters from the screen, but they are cleared from memory.

Control S will allow you to save your file to disk. The program asks you to name a file. Control L lists the control commands, which stay on the screen about fifteen seconds.

Control N puts you in an update mode to get a specific line to view it or change it. In the update mode you may enter a line number or issue a Control L to return to the main menu. If you input a line number, then the program offers you two options—Control L to redo a line or Control M to look at another line.

Control W writes to your printer. Depending on the kind of printer you have, you may have to make some adjustments before printing or change the program. Line 221 in the accompanying listing contains within the quotes a Control I followed by 80N, which is the command to the MX-80 to print an 80-character line.

Control R writes out your current file to disk. The program will ask for a name for the file.

Control A allows you to add lines in the middle of a document. Unlike real word processors, the pseudo requires whole lines to be entered. It does not reshape succeeding lines; it just pushes them back. You should pause a second or so while in the add mode when you start a new line. The program takes a little time to push the array back, which occurs right after you enter the first text character of an added line. If you add more than one line in this mode, the move back occurs at each new line.

Control T allows you to set a tab character other than the paragraph tab. This is nice for indented material.

Once in a while you will find that if there are too many onerrs, you have been tossed into limbo by Applesoft. If you find yourself in the monitor, type in 3D0G and hit return. You will be in Basic. Then type in GOTO 62, and you will get the master menu. Right then save your file and try to continue. If you still have trouble, Control C out and run again, calling in the saved file.

I'll be the first to admit that the pseudo is not going to give Wang or Muse or Apple pause for thought, but if you are on a limited budget, try it. You'll like it. □

Bruno B. Wolff, Jr., 2004 E. Kensington Blvd., Shorewood, WI 53211.

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2-Serial, 2-Parallel I/O Board —Fully buffered inputs and outputs. Includes ROM circuitry for 2716 2K EPROM (user supplied). Parallel ports have full four-line-per-port handshaking and 8-bit data transfer. Serial ports meet RS-232-C interface specs. Port A transmits and receives in asynchronous mode; Port B in either synchronous or asynchronous.
Part Number 2719-01 . . . . . Price: $280.00

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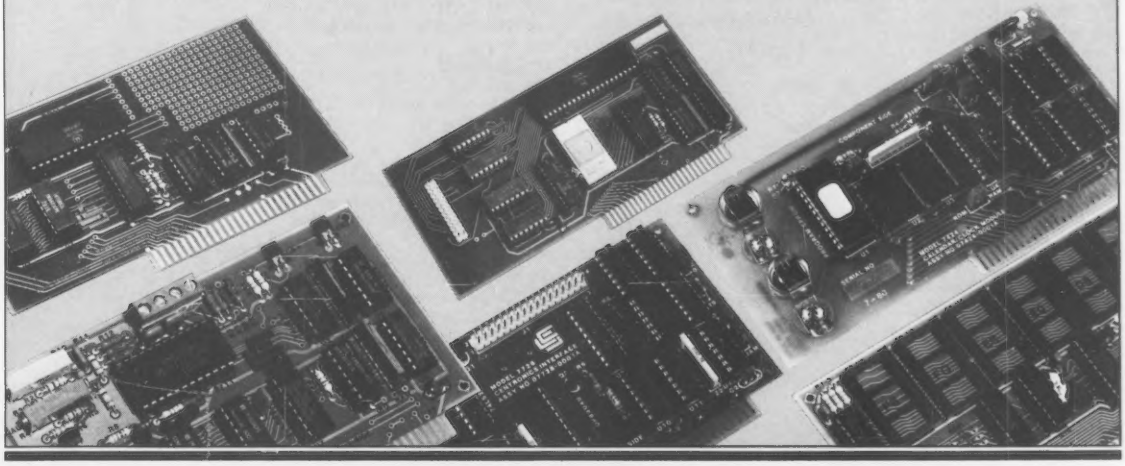

CIRCLE 109 ON READER SERVICE CARD

Word Processors, continued...

```
1 S$ = "X"
2  GOSUB 10042
10  DIM A$(200)
20 D$ =  CHR$ (4)
30  ONERR  GOTO 1260
40  HOME
45 PA = 1
50 N = 1
60  INPUT "IMPUT PARAGRAPH TAB ";A
70  INPUT "SECONDARY TAB ";T
80  INPUT "PAGE LENGTH ";L
90  HOME
100  PRINT "CONTROL CHARACTERS ARE:"
110 A1 = 0:A2 = 0
130  PRINT "  CONTROL A, ADD TO EXISTING FILE"
140  PRINT "  CONTROL B, CHANGE TABS"
150  PRINT "  CONTROL C, ABORT SESSION"
160  PRINT "  CONTROL D, DELETE LINES"
180  PRINT "  CONTROL L, LIST COMMANDS "
190  PRINT "  CONTROL N, UPDATE EXISTING FILE"
200  PRINT "  CONTROL P, PARAGRAPH"
210  PRINT "  CONTROL Q, POSITION CURSOR"
220  PRINT "  CONTROL R, READ FROM DISK"
230  PRINT "  CONTROL S, SAVE TO DISK"
235  PRINT "  CONTROL W, WRITE TO PRINTER"
240  GOSUB 1790
250  HOME
260  PRINT " YOU MAY NOW ENTER TEXT AT LINE ";N: PRINT " OR A CONTROL COMMAND"
270 K = 32
280  GET B$: IF A2 = 1 AND  ASC (B$) > 31 THEN  GOSUB 900
285  IF  ASC (B$) = 21 THEN  GOSUB 2100
290  IF  ASC (B$) = 12 THEN 100
292  IF  ASC (B$) = 11 THEN  PRINT D$;"CATALOG": GOTO 280
295  IF  ASC (B$) = 17 THEN  GOSUB 2000: GOTO 280
300  IF  ASC (B$) = 3 THEN 840
310  IF  ASC (B$) = 18 THEN 1130
320  IF  ASC (B$) = 1 THEN 1650
330  IF  ASC (B$) <  > 16 THEN 360
340  IF  LEN (A$(N)) > 1 OR N > 1 THEN N = N + 1: IF A1 = 1 THEN N = N + 1:
     GOSUB 900:N = N - 1:A3 = 0
350  GOSUB 850: GOTO 630
360  IF  ASC (B$) <  > 13 THEN 390
370 N = N + 1: IF  LEN (A$(N - 1)) < 1 THEN A$(N - 1) = " "
380  PRINT : GOTO 650
390  IF B$ =  CHR$ (19) THEN 1000
400  IF  ASC (B$) <  > 8 THEN 430
410  IF  LEN (A$(N)) = 1 THEN  PRINT B$;: GOTO 280
420 A$(N) =  LEFT$ (A$(N), LEN (A$(N)) - 1): PRINT B$;: GOTO 280
430  IF  ASC (B$) = 23 THEN 700
440  IF  ASC (B$) = 4 THEN  GOSUB 1850: GOTO 100
450  IF  ASC (B$) = 14 THEN 1340
460  IF  ASC (B$) = 20 THEN  GOSUB 880: GOTO 280
470  IF  ASC (B$) = 2 THEN 60
480  IF  ASC (B$) <  > 27 THEN 500
490 K = 0: INVERSE : GOTO 280
500  IF  ASC (B$) < 65 OR  ASC (B$) > 90 THEN K = 0
510  PRINT B$;
520  IF  ASC (B$) < 32 THEN 550
530 B$ =  CHR$ ( ASC (B$) + K)
540 A$(N) = A$(N) + B$
550  NORMAL
560 K = 32
570  IF  LEN (A$(N)) = 71 THEN 590
580  GOTO 280
590  GOSUB 910
600 N = N + 1: IF N > M THEN M = N
610  IF  LEN (A$(N)) > 0 THEN 625
620  PRINT : GOTO 650
625  HTAB J - 40: CALL  - 868
630  PRINT : FOR M1 = 1 TO  LEN (A$(N)):F$ =  MID$ (A$(N),M1,1): IF  ASC (F$)
     < 96 AND  ASC (F$) > 63 THEN  INVERSE
635  IF  ASC (F$) > 95 THEN F$ =  CHR$ ( ASC (F$) - 32)
640  PRINT F$;: NORMAL : NEXT M1
650  IF A1 = 1 AND A3 = 0 THEN A2 = 1
660  IF N > M THEN M = N
670 A3 = 0: GOTO 280
680  PRINT : IF A1 = 1 THEN A2 = 1
690 A$(N) = "": PRINT B$: GOTO 280
700  INPUT "ENTER NUMBER OF LINES OF SPACING 1 TO 3 ";N2
705 PA = 1
710  PR# 1: PRINT "
740  FOR J1 = 1 TO 3: PRINT : NEXT J1
745 NL = 3
750  FOR J = 1 TO M
760  PRINT A$(J)
765 NL = NL + N2
770  IF N2 > 1 THEN  PRINT : IF N2 = 3 THEN  PRINT
780  IF NL >  = L THEN NL = 0: GOSUB 1810
790  NEXT J
800  PRINT  CHR$ (12)
810  PR# 0
830  GOTO 100
840  END
850  FOR J = 1 TO A:A$(N) = A$(N) + " "
860  NEXT J
870  RETURN
880  IF  LEN (A$(N)) < 1 THEN A$(N) = " "
890  FOR M1 =  LEN (A$(N)) TO T:A$(N) = A$(N) + " ": PRINT " ";: NEXT M1: RETURN
900 A2 = 0: GOSUB 1730: RETURN
910 C$ = A$(N)
920  FOR J = 71 TO 50 STEP  - 1
930  IF  MID$ (C$,J,1) =  CHR$ (32) THEN 960
940  NEXT J
950  RETURN
960 A$(N) =  LEFT$ (C$,J)
970  IF A1 = 1 THEN N = N + 1: GOSUB 900:N = N - 1:A3 = 1
980  IF J < 71 THEN A$(N + 1) =  RIGHT$ (C$,71 - J)
990  RETURN
1000  INPUT "INPUT FILENAME ";E$
1010  PRINT D$;"OPEN ";E$
1020  PRINT D$;"DELETE ";E$
1030  PRINT D$"OPEN ";E$
1040  PRINT D$;"WRITE ";E$
1050  IF A$(M) = "" THEN M = M - 1
1060  FOR J = 1 TO M
1070  IF  LEN (A$(J)) < 1 THEN 1090
1080  PRINT A$(J)
1090  NEXT J
1100  PRINT D$;"CLOSE ";E$
1110  PRINT M;" LINES WRITTEN TO DISK": GOSUB 1790
1120  GOTO 100
1130  INPUT "INPUT FILENAME FOR LOADING ":E$
1140  HOME : FLASH : HTAB 16: VTAB 10: PRINT "LOADING": NORMAL
1150  PRINT D$;"OPEN ";E$
1160  PRINT D$;"READ ";E$
1165 A1 = 0
1170  FOR M = 1 TO 200
1180  CALL 768
1200 S$ =  MID$ (S$,1)
1210 A$(M) = S$
1230  NEXT M
1240  PRINT D$;"CLOSE ";E$
1260  IF  PEEK (222) <  > 5 THEN 1310
1270  HOME : PRINT " LOAD COMPLETED": PRINT
1280  PRINT "FILE SIZE IS ";M - 1
1285 N = M
1290  GOSUB 1790
1300  GOTO 100
1310  PRINT "ERROR CODE IS "; PEEK (222)
1320  GOSUB 1790
1330  GOTO 90
1340  PRINT " IN THIS MODE YOU'LL CALL FOR A LINE"
1350  PRINT " NUMBER"
1360  PRINT " OR RETURN TO MAIN MENU"
1370  PRINT " WITH CONTROL L AND RETURN"
1380  INPUT B$
1390  IF  ASC (B$) = 12 THEN 100
1400  IF  ASC (B$) < 48 THEN 1360
1410  IF  ASC (B$) > 57 THEN 1360
1420 P =  VAL (B$):N = P
1430  FOR M1 = 1 TO  LEN (A$(P))
1440 K = 0
1450 C$ =  MID$ (A$(P),M1,1)
1460  IF  LEN (C$) < 1 THEN  PRINT "LINE ";N;" IS A NULL": PRINT : GOTO 1570
```

```
1470  IF  ASC (C$) > 64 AND  ASC (C$) < 91 THEN 1490
1480  GOTO 1500
1490 K = 0: INVERSE : GOTO 1520
1500  NORMAL
1510  IF  ASC (C$) > 96 THEN K =  - 32: NORMAL
1520 C$ =  CHR$ ( ASC (C$) + K)
1530  PRINT C$;
1540  NEXT M1
1550  NORMAL
1560 : PRINT : PRINT
1570  PRINT "INPUT CONTROL L TO REDO THE LINE": PRINT "CONTROL N TO LOOK
      AT ANOTHER LINE"
1572  PRINT "CONTROL M TO RETURN"
1575 A1 = 0
1580  GET B$
1590  IF  ASC (B$) = 13 THEN 260
1600  IF  ASC (B$) = 12 THEN 1620
1605  IF  ASC (B$) = 14 THEN 1340
1610  GOTO 1570
1620 N = P
1630 A$(N) = ""
1640  GOTO 260
1650  PRINT "IN PUT LINE NUMBER AFTER WHICH"
1660  PRINT "YOU WANT TO INSERT NEW LINE"
1670  INPUT B$
1680 N =  VAL (B$)
1690 A1 = 1
1700 A2 = 1
1710 N = N + 1
1720  GOTO 260
1730  FOR Q = 200 TO N + 1 STEP  - 1
1740 A$(Q) = A$(Q - 1)
1750  NEXT Q
1760 A$(N) = ""
1770 M = M + 1
1780  RETURN
1790  FOR J1 = 1 TO 2000: NEXT J1: RETURN
1800  RETURN
1810  PRINT  CHR$ (12)
1815 PA = PA + 1
1820  FOR J1 = 1 TO 2: PRINT : NEXT J1
1830  IF PA > 1 THEN  HTAB 40: PRINT "PAGE ";PA: PRINT
1835  PRINT : PRINT
1840  RETURN
1850  INPUT "INPUT THE START AND END LINES TO DELETE ";A5,A4
1855 A1 = 0
1860  FOR N1 = A5 TO 200 - A4 + A5 - 1
1870 A$(N1) = A$(N1 + 1 + A4 - A5)
1880  NEXT N1
1890 M = M - A4 + A5 - 1
1900  RETURN
2000  VTAB 23: HTAB 1: CALL  - 858
2005  INPUT "INPUT CURSOR POSITION, VERT, HORZ ";V1,H1
2010  VTAB V1: HTAB H1
2020  RETURN
2100 C1 =  PEEK (37)
2110 C2 =  INT (C1 / 8)
2115 C3 = C1 - C2 * 8
2120 C4 = 1024 +  PEEK (36) + C2 * 40 + C3 * 128
2122 B1 =  PEEK (C4)
2125  IF B1 > 31 AND B1 < 96 THEN K = 0: INVERSE
2126  IF B1 < 32 THEN B1 = B1 + 32
2127  IF B1 > 96 THEN B1 = B1 - 128
2130 B$ =  CHR$ (B1)
2140  RETURN
10042  POKE 768,162: POKE 769,0: POKE 770,32: POKE 771,117: POKE 772,253: POKE
       773,160: POKE 774,2: POKE 775,138: POKE 776,145: POKE 777,105
10044  POKE 778,200: POKE 779,169: POKE 780,0: POKE 781,145: POKE 782,105:
       POKE 783,200: POKE 784,169: POKE 785,2: POKE 786,145: POKE 787,105
10046  POKE 788,138: POKE 789,168: POKE 790,185: POKE 791,0: POKE 792,2: POKE
       793,41: POKE 794,127: POKE 795,153: POKE 796,0: POKE 797,2: POKE 798,
       136: POKE 799,192: POKE 800,255: POKE 801,208: POKE 802,243: POKE 803,96
10048  RETURN
```


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CIRCLE 210 ON READER SERVICE CARD

Maze Race is a two-player car race for the PET.

It has been my observation that most car racing games that are designed for the Commodore/PET computers suffer from two weaknesses. First, they provide the player with only one track on which to race. This means that every time the game is played, the race is run on the same old track.

Second, most races are one-player games. This means that one can only race against time (which gets tiring after a while), not against another player. I don't know about you, but I find those games *very* boring and definitely not worthwhile.

Maze Race has neither one of the weaknesses mentioned above. The computer constructs a different maze (racing track) every time the game is played. It also constructs an identical maze at the righthand side of the screen for the other player. The first one who reaches his destination point, marked by (shift v) is the winner of the round. The overall winner is the first player who wins three rounds.

Maze Race also has a sound feature for PETs with a CB2 sound box.

The subroutine to draw the maze was taken from *Basic Computer Games* by David H. Ahl. □

```
100 REM 'MAZE RACE'
110 REM 'BY DARYOUSH MORSHEDIAN'
999 POKE59468,12:POKE59458,30
1000 PRINT"■■■■■"
1010 PRINT"              ■MAZE RACE!"
1020 PRINT:PRINT:PRINT:PRINT:SP$="■■■■■■■"
1030 PRINTSP$" DARYOUSH MORSHEDIAN":PRINT
1050 PRINTSP$"       JUNE, 1981"
1060 REM
1070 WA=500
1080 REM ***                    ***
1090 REM *** SCORE TO WIN (SW)***
1100 REM ***                    ***
1110 SW=3
1120 IF SW<1 THEN PRINT"SCORE TO WIN--- CAN'T BE <1,
     CHECK 70":STOP
1130 PS=22
1140 SR=32847
1150 DIM W(6,30),V(6,30)
1160 CF$="■■"
1170 CS$="■■"
1180 CH$=CF$
1190 FORI=1TO22:SP$=SP$+"■":NEXT:XF$="■■■■■■■
```

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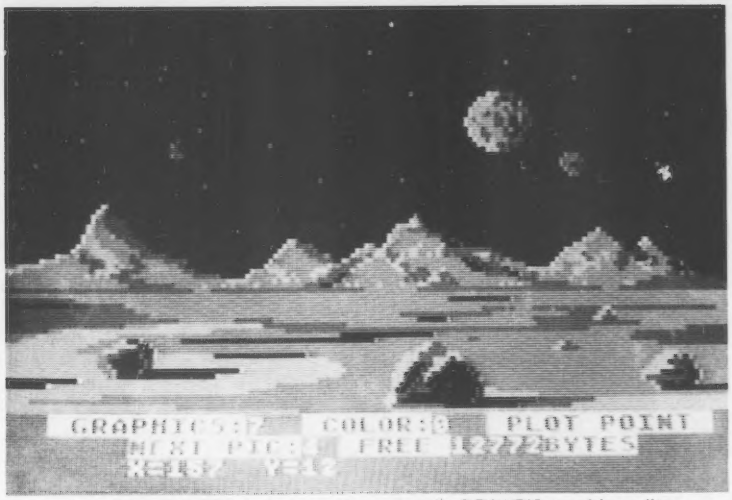

Scene from BETA FIGHTER during creation using the DRAWPIC graphics editor.

HODGE PODGE: by Marsha Meredith (Atari and Apple)

NOW AVAILABLE FOR ATARI!!! This captivating program is a marvelous learning device for children from 18 months to 6 years. HODGE PODGE consists of many cartoons, animation and songs which appear when any key on the computer is depressed. A must for any family containing young children.
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☐ **PM EDITOR:** by Dennis Zander (Atari, 16K)
Create your own fast action graphics game for the Atari 400 or 800 using its player missile graphics features. By using player data stored as strings, players can be moved or changed (for animation) at machine language speed. All this is done with string variables (PO$(Y)=SHIP4). This program is designed to permit creation of up to 4 players on the screen, store them as string data and then immediately try them out in the demo game included in the program. Instructions for use in your own game are included. PM EDITOR was used to create the animated characters in **ARTWORX** RINGS OF THE EMPIRE and ENCOUNTER AT QUESTAR IV.
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☐ **THE PREDICTOR** by Thomas Barker (Apple, Atari, TRS-80, North Star and CP/M (M-BASIC).
This is a complete package that covers least squares fitting of parameters for two or more variables. THE PREDICTOR can be used for predicting sales and process behavior, trend analysis, model building and many other uses calling for multilinear regression techniques. Each option in the program is prompted with simple YES/NO commands making it **very** easy to use.
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☐ **PILOT:** by Michael Piro (Atari, 16K)
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☐ **TEACHER'S PET:** by Arthur Walsh (Atari, Apple, TRS-80, PET, North Star and CP/M (MBASIC) systems).
This is an introduction to computers as well as a learning tool for the young computerist (ages 3-7). The program provides counting practice, letter-word recognition and three levels of math skills.
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☐ **MAIL LIST 3.0:** (Atari, Apple and North Star)
The very popular MAIL LIST 2.2 has now been upgraded. Version 3.0 offers enhanced editing capabilities to complement the many other features which have made this program so popular. MAIL LIST is unique in its ability to store a maximum number of addresses on one diskette (typically between 1200 and 2500 names!). Entries can be retrieved by name, keyword(s) or by zip codes. They can be written to a printer or to another file for complete file management. The program produces 1, 2 or 3-up address labels and will sort by zip code (5 or 9 digits) or alphabetically (by last name). Files are easily merged and MAIL LIST will even find and delete duplicate entries! The address files created with MAIL LIST are completely compatible with **ARTWORX** FORM LETTER SYSTEM.
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☐ **BRIDGE 2.0** by Arthur Walsh (Atari (24K), Apple TRS-80, PET, North Star and CP/M (MBASIC) systems)
Rated #1 by Creative Computing, BRIDGE 2.0 is the only program that allows you to both bid for the contract and play out the hand (on defense or offense!). Interesting hands may be replayed using the "duplicate" bridge feature. This is certainly an ideal way to finally learn to play bridge or to get into a game when no other (human) players are available.
PRICE ..... **$17.95** cassette **$21.95** diskette

☐ **ENCOUNTER AT QUESTAR IV:** by Douglas McFarland (Atari, 24K)
As helmsman of Rikar starship, you must defend Questar Sector IV from the dreaded Zentarians. Using your plasma beam, hyperspace engines and wits to avoid Zentarian mines and death phasers, you struggle to stay alive. This BASIC/Assembly level program has super sound, full player missile graphics and real tittle action.
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NEW PROGRAMS!

HAZARD RUN: by Dennis Zander (Atari, 16K)
The sheriff has spotted you and you must make the treacherous run through Crooked Canyon past Bryan's Pond to the jump at Hazard Creek and safety. You can even put the joystick-controlled GEE LEE car up on two wheels to make it through some tight spots. A lead foot is not always the answer as you dodge trees, rocks and chickens in this nerve-racking game. HAZARD RUN employs full use of player/missile graphics, re-defined characters and fine scrolling techniques to provide loads of fast action and visual excitement.
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BETA FIGHTER: by Douglas McFarland (Atari, 16K)
See who will be the ace gunner in this action game set on a spectacular Martian landscape. BETA FIGHTER can be played with one or two players and uses player/missile graphics and delightful sound effects.
PRICE.....**$16.95** cassette **$20.95** diskette

DRAWPIC: by Dennis Zander (Atari 16K)
DRAWPIC provides the user with an unbelievably easy way to create screens in graphics modes 3-7. Just sit back with your joystick and use POINT PLOT, DRAW LINE, RUBBER BAND fill and COLOR SET to create beautiful images on your Atari. Full or partial screen images are saved as string data in the program and can be instantly recalled and combined into new images using machine language subroutines. These graphic images can be easily incorporated into your own programs. The images of HODGE PODGE and the landscape of BETA FIGHTER were made using DRAWPIC.
PRICE ..... **$29.95** cassette **$33.95** diskette

T: A TEXT DISPLAY DEVICE: by Joseph Wrobel (Atari 16K)
T: is an auto-loading, co-resident assembly language routine which greatly expands the display capabilities of the Atari. It allows you to freely intermix both text and graphics without the use of modified display lists, PEEKS or POKES. This is done by defining a new device ("T:"); printing to that device puts text onto the screen. The size of the text is determined by the graphics mode used.
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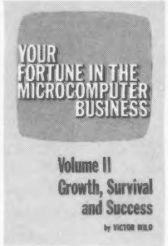

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CIRCLE 254 ON READER SERVICE CARD

Maze Race, continued...

```
1970 X=INT(RND(X)*2+1)
1980 ON X GOTO 2340,2470
1990 GOTO 2340
2000 IF S-1=0 THEN 2190
2010 IF W(R,S-1)<>0 THEN 2190
2020 IF R=H THEN 2120
2030 IF W(R+1,S)<>0 THEN 2120
2040 IF S<>V THEN 2070
2050 IF Z=1 THEN 2100
2060 Q=1:GOTO 2080
2070 IF W(R,S+1)<>0 THEN 2100
2080 X=INT(RND(X)*3+1)
2090 ON X GOTO 2380,2420,2470
2100 X=INT(RND(X)*2+1)
2110 ON X GOTO 2380,2420
2120 IF S<>V THEN 2150
2130 IF Z=1 THEN 2180
2140 Q=1:GOTO2160
2150 IF W(R,S+1)<>0 THEN 2180
2160 X=INT(RND(X)*2+1)
2170 ON X GOTO 2380,2470
2180 GOTO 2380
2190 IF R=H THEN 2280
2200 IF W(R+1,S)<>0 THEN 2280
2210 IF S<>V THEN 2240
2220 IF Z=1 THEN 2270
2230 Q=1:GOTO2390
2240 IF W(R,S+1)<>0 THEN 2270
2250 X=INT(RND(X)*2+1)
2260 ON X GOTO 2420,2470
2270 GOTO 2420
2280 IF S<>V THEN 2310
2290 IF Z=1 THEN2330
2300 Q=1:GOTO2320
2310 IF W(R,S+1)<>0 THEN 2330
2320 GOTO2470
2330 GOTO 2570
2340 W(R-1,S)=C
2350 C=C+1:V(R-1,S)=2:R=R-1
2360 IF C=H*V+1 THEN 2600
2370 Q=0:GOTO 1670
2380 W(R,S-1)=C
2390 C=C+1
2400 V(R,S-1)=1:S=S-1:IF C=H*V+1 THEN 2600
2410 Q=0:GOTO1670
2420 W(R+1,S)=C
2430 C=C+1:IF V(R,S)=0 THEN 2440
2435 V(R,S)=3:GOTO2450
2440 V(R,S)=2
2450 R=R+1
2460 IF C=H*V+1 THEN  2600
2465 GOTO2000
2470 IF Q=1 THEN 2530
2480 W(R,S+1)=C:C=C+1:IFV(R,S)=0 THEN 2500
2490 V(R,S)=3:GOTO2510
2500 V(R,S)=1
2510 S=S+1:IFC=H*V+1 THEN 2600
2520 GOTO 1670
2530 Z=1
2540 IF V(R,S)=0 THEN 2560
2550 V(R,S)=3:Q=0:GOTO2570
2560 V(R,S)=1:Q=0:R=1:S=1:GOTO1660
2570 GOTO 1610
2580 TJ=TJ+1:IF TJ=2 THEN 2840
2590 PRINT"[CLR]"
2600 FOR J=1 TO V
2610 PRINT TAB(TB)CH$;
2620 FOR I=1 TO H
2630 IF V(I,J)<2 THEN 2660
2640 PRINT TAB(TB)"   ";
2650 GOTO 2670
2660 PRINT TAB(TB) "  "CH$;
2670 NEXTI
2680 PRINT
2690 FOR I=1 TO H
2700 IF V(I,J)=0 THEN 2740
2710 IF V(I,J)=2 THEN 2740
2720 PRINT TAB(TB)CH$"  ";
2730 GOTO 2750.
2740 PRINTTAB(TB) CH$;CH$;CH$;
2750 NEXTI
2760 PRINTTAB(TB) CH$:NEXTJ
2770 IFTJ=1THENPRINTTAB(22)CH$;TAB(37)CH$:
     PRINTTAB(22);:FORNP=1TO16:PRINTCH$;:NEXT:GOTO2790
2780 PRINT CH$;TAB(15);CH$:FORNP=1TO16:PRINT CH$;:NEXT
2790 TB=PS:IF RE=0THENRE=1:GOSUB3290
2800 FORV=1TO16:PL=SR+V:PF=PEEK(PL)
2810 IF PF<>32 THEN POKE PL+PS,PO
```

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CIRCLE 162 ON READER SERVICE CARD

Maze Race, continued...

```
2820 NEXTY:CH$=CS$
2830 GOTO 2580
2840 REM
2850 REM ****GAME****
2860 PRINT"■":FORRW=1TO23:PRINTTAB(16)"      ":NEXTRW
2870 PC=33689:PF=33711
2880 P1=PF:P2=PC
2890 C1=42:C2=81
2900 E2=32808:E1=32830
2910 POKE P1,C1:POKE P2,C2
2920 FORIP=1TO2000
2950 NEXTIP
2960 REM
2980 POKE 59467,16:POKE 59466,15
2990 FORN=1TO3:PRINT"
     ■▶▶▶
```

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CIRCLE 276 ON READER SERVICE CARD

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Chuck Carpenter

Several readers have asked about machine language entry points for hi-res graphics. By coincidence, an excellent source of the entry points showed up at just the right time. We'll feature the hi-res entry points in the column this month. As we have in previous columns, one-liners from readers will be included, as will the questions 'n answers section. I'll also discuss a new software utility which I think you will like.

Hi-Res Entry Points

Applesoft Basic includes several commands and statements for writing hi-res graphics programs. Most of the time programs using these commands are quite adequate. Many times though, the programmer wants a quicker response. To achieve this, you can take advantage of the machine language routines included in the ROMs in the Applesoft Basic Interpreter. That is, if you know where the routines are located in memory. (Note that the routines are in the same place if you have Applesoft loaded into a RAM card, too.)

The December '81 issue of the *Apple Assembly Line* newsletter solved the problem, and with the permission of Bob Sander-Cederlof of S-C Software, the hi-res entry information is paraphrased here. But first, some preliminary information for those of you who are new to machine language.

Chuck Carpenter, 2228 Montclair Pl., Carrollton, TX 75007.

6502 Registers

As you read through the descriptions of the hi-res routine memory locations and their use, you will see references to the A, X, and Y registers. These are internal 6502 microprocessor memory locations. These registers are used to process variables (data) during computing functions. The A register is the accumulator. The X and Y registers are called Index registers. As you will see in the descriptions, you must provide the values needed for the machine language programs to function. Your program must store the data in the appropriate register before the hi-res routine is called.

To better understand how this is done, a knowledge of machine language is required. Three tutorials have been included in this column, one in the May '80 issue and two in the November '80 issue. There are also many good books on the subject, including *Apple Machine Language* by Don and Kurt Inman and *6502 Software Design* by Leo J. Scanlon. Since the first one is Apple oriented, it is an excellent book for the machine language beginner. Now, let's look at the hi-res subroutines in the Applesoft Interpreter.

Hi-Res Subroutines

Table 1 is a list of the important locations used in page zero. These locations help keep track of what is going on during the computation process.

Table 2 shows the major entry points you can use for your hi-res machine language.

Table 1.

$1A,1B	Shape pointer used by DRAW and XDRAW
$1C	Last used color byte
$26,27	Address of byte containing x,y point
$30	Bit mask for bit in that byte
$E0,E1	X-coordinate (0-279)
$E2	Y-coordinate (0-191)
$E4	Color
$E6	Page ($20 if HGR, $40 if HGR2)
$E7	SCALE= value
$E8,E9	Address of beginning of shape table
$EA	Collision counter
$F9	ROT= value

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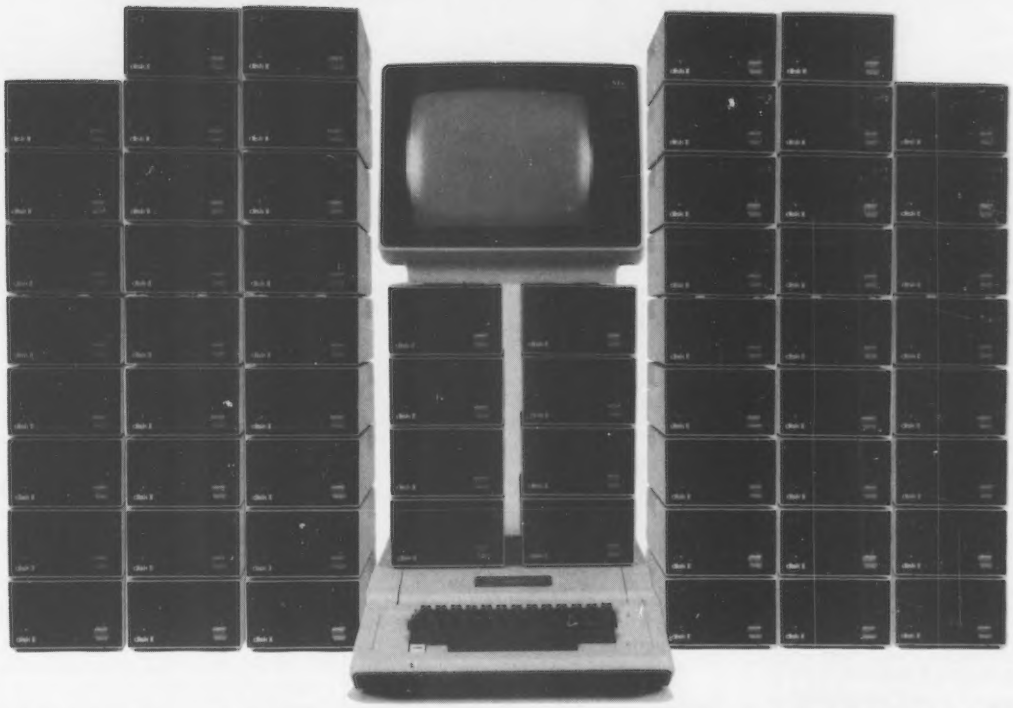

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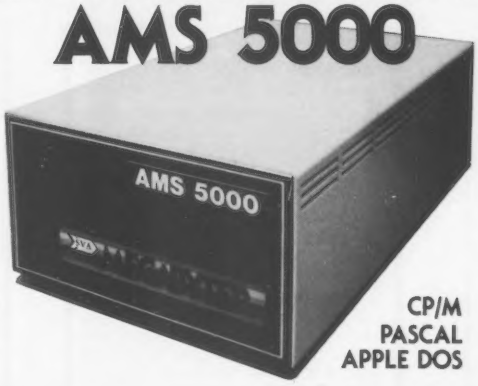

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Table 2.

HGR2	$F3D8	Initializes and clears hi-res page 2.
HGR	$F3E2	Initializes and clears hi-res page 1.
HCLR	$F3F2	Clears the current hi-res screen to black.
BKGND	$F3F6	Clears the current hi-res screen to the last plotted color (from $1C).
HPOSN	$F411	Positions the hi-res cursor without plotting a point. Enter with (A) = Y-coordinate, and (Y,X) = X-coordinate.
HPLOT	$F457	Calls HPOSN and tries to plot a dot at the cursor position. If you are trying to plot a non-white color at a complementary color position, no dot will be plotted.
HLIN	$F53A	Draws a line from the last plotted point or line destination to (X,A) = X-coordinate, and (Y) = Y-coordinate.
HFIND	$F5CB	Converts the position of the hi-res cursor's position to X- and Y-coordinates; stores X-coordinate at $E0-E1 and Y-coordinate at $E2.
DRAW	$F601	Draws a shape. Enter with (Y,X) = the address of the shape table, and (A) = the rotation factor. Uses the current color.
XDRAW	$F65D	Draws a shape by inverting the existing color or the dots the shape draws over. Same entry parameters as DRAW.
SETHCOL	$F6EC	Sets the hi-res color to (X), where (X) must be between 0 and 7.

One-Liners

This month, we have two one-liners from one of our junior programmers. The programs are hi-res and are shown in Listings 1 and 2. The first one draws random triangles in random colors with sound. The second draws random lines in random color. My guess is that Mike was experimenting when these programs were written.

One note about typing one-liners. Enter the text of the program without spaces. Some of the programs have too many characters after being listed. The Basic Interpreter inserts spaces to make the program easier to read. Often the extra spaces make the program too long for direct entry. As you may recall, only 255 characters can be typed into the keyboard input buffer, but if you leave out the spaces, an apparently too long program will fit in the buffer.

A couple of one-page programs were sent to me too. They are called one-pagers because the entire program fits on the screen when listed. Since I had an extra

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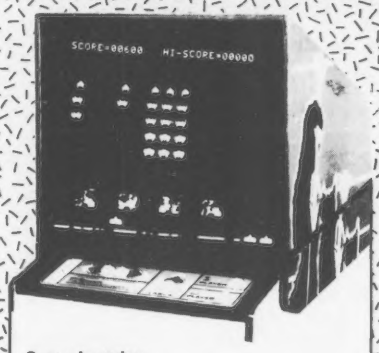


Super Invasion
Apple II (requires paddles)
licensed from Astar International
48K Diskette DOS 3.3 CS-4505 $19.95
16K Cassette CS-4006 $19.95
Sorcerer 16K Cassette CS-5011 $19.95
by Matt Hickey

This is the original arcade game, with superb high resolution graphics, high speed action, nail biting tension, and hilarious antics by the moon creatures. Fifty five aliens whiz across the screen, quickening their descent, challenging you to come out from behind your blockades and pick them off with your lasers before they bomb you, destroy your shields, or drop down right on top of you.

Super Invasion by John Varela
32K TRS-80 Model I Diskette CS-3520 $19.95
16K TRS-80 Cassette CS-3020 $19.95

A low resolution, high speed arcade game similar to our Apple and Sorcerer versions. The aliens move back and forth across the screen, dropping ever lower to attack you as you attempt to destroy them with your lasers.

Blisterball and **Mad Bomber**
By Rodney McCauley
Apple II 48K Diskette DOS 3.3 (requires paddles) CS-4511 $24.95

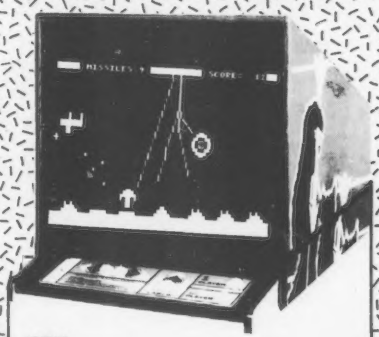
A frantic, fast paced romp that can be played for hours, **Blisterball** is the first truly original arcade-type game for a home computer. As the bouncing balls drop from above, the player moves his laser base and tries to shoot them. It's easy at first—with just one ball. Then come two, then three. It's getting harder. Four balls come, and finally five. Surviving them, the player gets to shoot at inelastic bonus balls. If he makes it this far, the second round starts. The balls bounce lower, the walls close in. Shades of Poe and Newton! Making Superb use of Apple graphics and sound, **Blisterball** can be played by one or two people. **Mad Bomber**, included on the same disk, is another fast paced arcade game. Racks of bombs fill up above you. Whenever four bombs are in any rack, they start to fall. You can shoot them either in the rack or while they are falling, but since there are racks all across the top of the screen, you need to stay ahead of them to survive.

Tsunami
by Rodney McCauley
Apple II 48K Diskette DOS 3.3 (requires paddles) CS-4526 $29.95

Wave after wave of alien attackers attempt to overwhelm your defenses. Each wave comes in a different formation and uses different attack and defense strategies. You get dozens of superior arcade games combined into one program. If you ever master the first set of games on the diskette, where the attackers are without shields, then you are ready for the second set. This time the attackers are sheltered by shields. They can drop bombs right through the shields, but you cannot shoot through them. Successive waves use different strategies. Some move from shield to shield, allowing you to shoot while they are in between. Others just come out briefly to attack, and you must have fast reflexes to get them. Bonus points are awarded for beating the clock, with a countdown timer displayed on screen. This may be our finest arcade game ever!

Torax
by Erol Pekoz
Apple II 48K Diskette DOS 3.3 (requires paddles) CS-4520 $24.95

Defend your home planet against the invading Torids! Try to protect your nuclear fuel tanks, which the aliens are intent on stealing. The Torids drop down, steal a fuel tank and rise up to escape. They are also armed, and will not hesitate to shoot at you. While you whiz by the surface of your planet at incredible speed, you must avoid enemy fire, maneuver your ship, and try to shoot down the Torids without hitting the fuel tanks!



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TRS-80 VISA

Sorcerer Apple II

```
LIST
10  REM        ONE LINER
               BY: MIKE CAMERON

20  HGR2 : FOR A = 1 TO 100: HCOLOR=
      INT ( RND (1) * 7):X =  INT
      ( RND (1) * 250 + 10):Y =  INT
      ( RND (1) * 170 + 10): HPLOT
      X,Y TO X - 4,Y - 9 TO X + 4,
      Y - 9 TO X,Y:S =  PEEK ( - 1
      6336): FOR W = 1 TO 150: NEXT
      W: HCOLOR= 0: HPLOT X,Y TO X
       - 4,Y - 9 TO X + 4,Y - 9 TO
      X,Y: NEXT
```

Listing 1. Draws random diamonds in color with sound.

```
]LIST
10  REM        ONE LINER
               BY: MIKE CAMERON

20  HGR2 : HCOLOR=  INT ( RND (1)
      * 7): HPLOT 0,0: FOR Z = 1 TO
      300:X =  INT ( RND (1) * 279
      ):Y =  INT ( RND (1) * 191):
       HPLOT  TO X,Y: NEXT : FOR X
       = 1 TO 300: NEXT : GOTO 10
]
```

Listing 2. Draws random lines in color.

day off because of an ice storm, I decided to enter the programs and include them here (remember the January '82 cold wave). Both are very interesting programs. I think you will especially enjoy the lo-res graphics program in Listing 4.

Listing 3 is an adaptation of the lo-res kaleidoscope program in the original Apple II Reference Manual. This book, known as the Red Book, included several Integer Basic programs, a couple of which were interesting games using lo-res graphics. This program is an interesting adaptation of the old lo-res program. The program runs very slowly, so give it plenty of time. The patterns that are developed are worth the wait. Bring your camera and take pictures.

How many Apple II Plus owners know about Integer Basic? If you have the Integer Card or a RAM card, I'm sure you have used Integer Basic. The language is the original Apple language and was developed for games and educational applications. It runs much faster than Applesoft for most applications—especially graphics programs.

The program in Listing 4 was written in Integer Basic and the results are fascinating. One of the features of the program is that it switches pages. That is, while you are looking at one page, a new display is being developed on the other. All of a sudden the display changes when the pages are switched. The process then continues on the other page. Fascinating!

When you first run the program, it displays two lines of text. Follow the instructions, set LOMEM and then type the GOTO. Now sit back and watch the display. It takes several seconds to get started, so give it a chance. I used my green-screen monitor and the results were very good, but it is much better viewed in color. If you would like to use this program in Applesoft you will need to change the INT statements. Otherwise the program should run properly. I'm not going to say what it does. Type it in and run it; you'll like it.

QUESTIONS 'N ANSWERS

Frequently, readers write to me and ask questions about all sorts of Apple related things. (Even about Apple and IBM!) The questions are often specific; something the individual reader is interested in. Other times the questions are general in nature and concern topics of interest to many readers. The questions asked most often are about connecting printers, adding on-line storage, and using RAM cards.

About Printers

Basically, printers come in two types. There are Receive Only (RO), and Keyboard Send/Receive (KSR). Generally, a KSR printer will have a keyboard attached to the printer. You can use the printer to send and to receive. An RO printer will only receive the data sent to it. Since there is no keyboard, RO printers are often more compact.

There are also serial printers and parallel

Listing 3. Hi-res version of the old Red Book Lo-Res Graphics program.

```
10  REM   HIGH RES KALEIDOSCOPE
20  REM   ADAPTED FROM LOW RES
22  REM   KALEIDOSCOPE (RED BOOK)

30  REM   BY: STUART RANKIN

40 E = 30: HGR2 : HOME : FOR W =
     3 TO 1000: FOR I = 0 TO 95: FOR
     J = 0 TO 95
100 K = I + J
110 A =  INT (2.65 * J / (I + 32)
     + I * W / E)
120 A =  ABS ( INT (A - .99999))
130  IF A > 7 THEN E = E * 50:A = 7
140  HCOLOR=  INT (A)
150  HPLOT I,K: HPLOT K,I: HPLOT
     278 - I,190 - K: HPLOT 278 -
     K,190 - I
160  HPLOT K,190 - I: HPLOT 278 -
     I,K: HPLOT I,190 - K: HPLOT
     278 - K,I
170  NEXT J,I,W: END
```

Listing 4. Lo-res graphics in Integer Basic. Draws on both pages and switches when complete. Very interesting program.

```
 0 REM    ONE PAGER
          BY:   L. J. TIBBITTS

 1 CALL -936: PRINT "LOMEM: 6000"
   : PRINT "GOTO 10": END
 2 X= RND (14)*3:Y= RND (14)*3
   : IF X<Y THEN RETURN : GOTO 2
 5 GOSUB 2:A=X:B=Y: GOSUB 2: FOR
   I=A TO B: COLOR=C: HLIN X,Y AT
   I: NEXT I: COLOR=0
 7 VLIN A,B AT X: VLIN A,B AT
   Y: HLIN X,Y AT A: HLIN X,Y AT
   B: RETURN
10 CALL -936: GR : REM  TIBBITTS
102 COLOR= RND (15)+1: FOR I=1 TO
   28: HLIN 1,38 AT I: NEXT I:
    GOTO 124
110 C= RND (15)+1
120 FOR K=1 TO RND (10): GOSUB
   5: NEXT K: IF RND (10)>1 THEN
   110: POKE -16300,0
124 FOR J=0 TO 1024: POKE 2048+
   J, PEEK (1024+J): NEXT J
126 POKE -16299,0: GOTO 110
```

A REMARKABLE MAGAZINE

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You might think the term "creative computing" is a contradiction. How can something as precise and logical as electronic computing possibly be creative? We think it can be. Consider the way computers are being used to create special effects in movies—image generation, coloring and computer-driven cameras and props. Or an electronic "sketchpad" for your home computer that adds animation, coloring and shading at your direction. How about a computer simulation of an invasion of killer bees with you trying to find a way of keeping them under control?

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printers available in both types. You can use some serial printers as-is, without any control signals other than the data lines. Other serial printers require handshaking, a term used to describe the way in which the computer and printer talk to each other. Parallel interface printers include handshaking as part of the computer-to-printer connections.

The DEC LA-34 is a KSR serial printer that does not require handshaking. You can use the Apple II High Speed Serial Interface Board with this printer, for instance. The LA-34 will print at 300 baud (30 characters per second), but runs as fast as 45 characters in the catch-up mode, after a carriage return.

The LA-34, since it is KSR with an RS-232 serial interface, can also be used with a modem to talk directly to a host computer. You can take advantage of the wide printing width to see output as it would be printed on an 80-character screen. You will use a great deal of paper, however. Be aware too, that you must switch the transmitted data and received data lines when a printer is used with a modem. Normally, these lines are pins 2 and 3 in the standard 25-pin connector.

Other serial printers can accept data at much higher speeds. For instance, my Epson MX-80 with a serial adapter, runs at 1200 baud (and will run as high as 9200 baud). The print head can't run at this speed, so the input buffer must tell the computer when it is full of characters. At this time the handshaking signals tell the computer to stop sending. When the buffer is cleared, another signal is sent to start the data again. Note that in this mode, it is of no advantage to send the data any faster than the print head can move.

If you have a system that allows spooling or buffering of data during the print cycle, the high speed transmission is more important. You can keep the spooling operation from loading other computing functions with higher transmission speeds. At least one manufacturer is making a card that will let you print and do other functions at the same time. Some word processors provide this capability too. Both functions slow down since the microprocessor must handle both functions. The faster the print buffer is filled, the sooner other functions are taken care of.

There are several serial interface cards on the market now which include handshaking. Since even the standard RS-232 serial interface allows many handshaking options, make sure the interface card and the printer are compatible.

Parallel printers, on the other hand, send the data as fast as the computer can send it all the time. Handshaking is built into the parallel interface. But not all parallel interfaces are the same.

My MX-80 and Centronics 737 are both parallel RO printers. The parallel card used for the 737 will not work with the MX-80. Manufacturers have tended to use the phrase "Centronics-compatible" but some are "more" compatible than others. Again, there are many parallel interface boards on the market now. Make sure the interface board works with the printer that you want to use.

About Disk Drives

Several companies are making expansion drives for the Apple system. Among these are Sorento Valley Associates (SVA), Vista, and Micro-Sci. The first two are offering controller cards and software for expansion to 8" drives. Micro-Sci claims to have 5 1/4" expansion drives and software for the Apple.

My experience has been only with SVA, a company which has a good reputation. With their controllers you can add up to 4 megabytes of on-line storage capacity in floppy drives. This capacity is provided through double-sided, double density controller capacity.

SVA has also announced controllers for 8" and 5 1/4" fixed (or rigid) drives. The software on the 8" system is integrated with DOS 3.3. You can have both the Apple controller card and the SVA controller card in the system at the same time.

The other two companies are new in the Apple disk drive business. Vista has been around a while, but I am not familiar with their products. Vista has announced a controller and Apple compatible software for 8" drives. The system is reported to be very much like the SVA units.

Micro-Sci started about a year ago and had problems. They advertise a 40-track drive and a 70-track drive. Software was reported to be the major problem by those with whom I have discussed the products. The 40-track drive does not offer much in the way of additional capacity. With the 70-track unit, you get about 1/4 megabyte of storage—about as much as a single-sided 8" disk. As I learn more about these disk drive memory expansion systems, I will keep you informed.

About RAM Cards

Adding a RAM card to the Apple brings us in a complete circle. Now you can "softload" many languages and utilities into addressable memory occupied by ROM. A few years ago, the rage was to have a computer that had the programming language in ROM. When you turned on the power, the language was ready to use immediately. Of course, if you had to load programs from tape, you could understand why programs in ROM were so desirable. Now, with fast access disk drives, the more flexible softload capability has gained popularity.

Apple's Language System included the first RAM card that I know of. It is part of the package you get when you buy Pascal. Several other manufacturers offer 16K RAM cards, most of which are quite similar to the Apple RAM card. You can load Integer Basic, Applesoft Basic, Pascal or Fortran, or use the Z-80 Softcard with them. The units have switches in software and hardware to connect or remove them from the memory circuits.

One supplier has a unit that has its own memory refresh circuits on it. This means that you don't have to remove any of the RAM chips on the main Apple board. However, my feelings are uneasy here; the logic is good, but there is always the possibility that refresh will occur at the wrong time. I prefer those boards which get their refresh timing from the same circuits the main Apple memory does.

Newer RAM boards now have capacities of 32K, 64K, and 128K bytes of memory. With this kind of capacity you could store the total contents of an Apple disk in RAM. In fact, that is the claim made for these memory giants. Other possibilities include

ADVENTURES!!!

16 K COLOR 80 or 8KOS1. These Adventures are written in BASIC, are full featured, fast action, full plotted adventures that take 30-50 hours to play. (Adventures are interactive fantasies. It's like reading a book except that you are the main character as you give the computer commands like "Look in the Coffin" and "Light the torch.") $14.95 each.

ESCAPE FROM MARS (by Rodger Olsen)

This ADVENTURE takes place on the RED PLANET. You'll have to explore a Martian city and deal with possibly hostile aliens to survive this one. A good first adventure.

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This is our most challenging ADVENTURE. It is a treasure hunt in a pyramid full of problems. Exciting and tough!

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The easy way to speed in your programs. The tiny compiler lets you write and debug your program in Basic and then automatically compiles a Machine Code version that runs from 50-150 times faster. The tiny compiler generates relocatable, native, transportable machine code that can be run on any 6502 system.

It does have some limitations. It is memory hungry — 8K is the minimum sized system that can run the Compiler. It also handles only a limited subset of Basic — about 20 keywords including FOR, NEXT, IF THEN, GOSUB, GOTO, RETURN, END, STOP, USR(X), PEEK, POKE, -, =, *, /, , <,> , Variable names A-Z, and Integer Numbers from 0-64K.

TINY COMPILER is written in Basic. It can be modified and augmented by the user. It comes with a 20 page manual.

TINY COMPILER—$19.95 on tape or disk. OS1.

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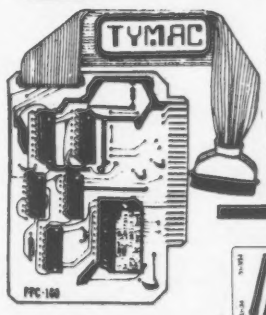

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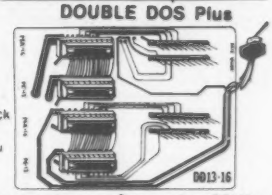

DOUBLE DOS Plus—a piggyback board that plugs into the disk controller card so that you can switch select between DOS 3.2 and DOS 3.3

Nothing needs to be soldered, just plug in and go. Since all four ROMS are used, all software will work, the ROMS fit on the back of the board allowing full use of slot #7. One set of ROMS is powered up at a time.

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Apple Cart, continued...

moving DOS (the disk operating system) into this area of memory. You can get an additional 10K bytes of main memory for your programs this way. Note that the software must be compatible with DOS for these things to work properly.

A technique called bank switching is used to access a particular 16K section of the additional RAM memory. Addresses are used as bank switching registers. When a switching register is called, the appropriate 16K section is selected, and the programs stored there run accordingly. With just one 16K section, the usual result is to switch ROM with RAM. The result is similar to having Applesoft resident in ROM on the Apple main board, and an Integer Basic card in slot zero. You can switch one or the other on with the hardware switch, or make the switch with a software call. Most of the software available these days has the intelligence to make the analysis during boot time. That's how the master disk knows whether to load the non-resident language into a RAM card if it is installed in slot zero.

A Fast-Load Utility

Speaking of fast loading memory, a new utility called Universal Boot Initializer (UBI) will do this for you. As I mentioned above, loading programs from tape was sometimes agonizingly slow. When Applesoft was first available, it took 1.5 minutes to load it from tape. The same program takes 20 seconds from a disk. Now with UBI, you can load your system with the non-resident language in less than five seconds. Actually, if you measure only the one time it takes to load a RAM card, the time is less than two seconds.

UBI is a product of S&S Software, Box 5, Manvel, ND 52856. The utility is designed to provide the software developer or end user with universal boot capability. This means you can load DOS 3.2.1 or 3.3 from the same disk. In addition to the copy protected utility disk, the package includes a thorough training disk and a manual to help configure your own personal boot disk. Examples of single and dual language possibilities are included too, for a total of four sides of software.

There was only one thing I didn't like about the utility. You can't directly add the capability to an existing disk. However, once you initialize a blank disk, you can use a file transfer utility like FID on DOS 3.3 to move files from a slow boot disk to a UBI initialized disk.

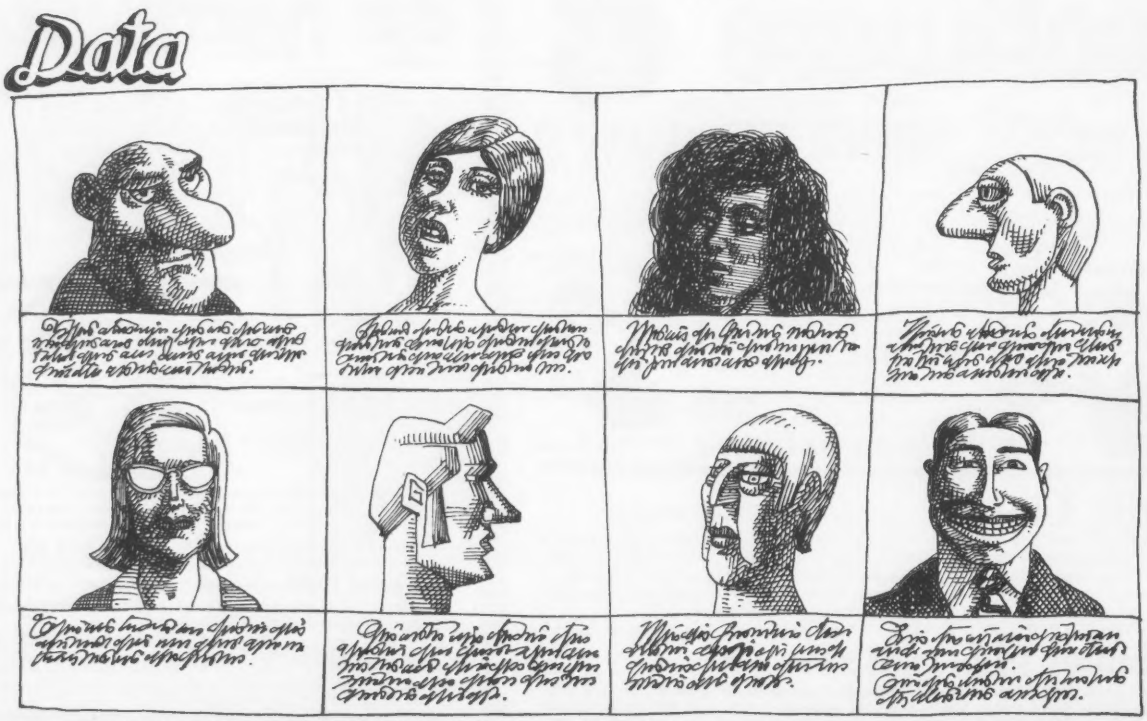
The well organized manual includes more than most people want to know about how the utility works. In addition to the sections on customizing your own boot disk, the manual tells you how the UBI came about, and includes a complete section on how to copy the universal boot disk.

Because of a problem that occurs when you include both DOS 3.2.1 and 3.3 on the same disk, they become difficult to copy. The manual suggests ways to overcome the problem, including the FID method, and use of a bit copier.

Warranty and replacement policies are quite liberal. Defective disks are replaced at no charge within 30 days. User damaged disks are replaced for $15 with return of the original disk. A back-up copy of the original disk is available for $10 with return of the warranty card.

For the software developer, a software licensing agreement is available. The individual end-user does not need a license. UBI also includes a directory formatting capability. However, additional software is required to create the customized catalog.

The disks that I use frequently have been modified with UBI. I have been delighted with it since I first saw the prototype model in July '81. If you have felt that two-stage booting was more than you needed at times, then you will enjoy the fast-load, single-step capability offered with the UBI. The price is $49.95 plus $3 postage and handling. The phone number is (701)696-2574. □



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Educational Excellence

Excellent educational software is the exception rather than the rule.

Excellence in educational software. It's not easily achieved.

Many large publishers have entered the computer software business. Many have flopped. Why? Because producing good software is not the same as producing a textbook.

Tough Criteria

Good educational software must meet specific objects in the teaching/learning process. It must motivate and hold the attention of the students. It must not bore the gifted students nor be over the heads of slower students. It must be "user friendly" to both the teacher and student. And it must be accompanied by clear support material, worksheets and all the material necessary to use it effectively.

A tall order.

But one which MECC has met.

The Minnesota Educational Computer Consortium (MECC) was founded in 1973 with the goal of extending the benefits of computers to every school in the state. Over the years, MECC has developed procedures for finding and perfecting programs from contributors throughout the state.

Few Programs Qualify

Before a program is accepted for the MECC library it is judged on specific criteria. For example:

1) Accuracy...Is all spelling and grammar correct? Does each question provide for a correct and appropriate response?

2) Audience...Is the intended audience (grade level and subject) served by the degree of difficulty and scope of the program? Is the reading level of the text material suitable?

3) Clarity...Are explanations and instructions sufficient, clear and straight forward? Is the presentation well-formatted?

4) Graphics...Are the graphics appropriate and sufficient in quantity?

Other criteria include documentation, function, programming, and the like. Similar criteria are applied to the documentation. This insures that the reading level is appropriate, that objectives are well-stated and that associated materials are available.

What this all means is that the educational software packages from MECC are among the best available anywhere. They are pedigogically sound, thoroughly tested and well documented.

Now the MECC software library is available to both schools and individuals through Creative Computing Software.

MECC software is currently available only on disk for the Apple II. All disks run under DOS 3.2 and require a minimum of 32K memory and Applesoft in ROM or an Apple II Plus.

Software using a printer uses the Apple serial, parallel or communications card.

Apple Demonstration Diskette
MECC-701, $19.95

A sample of the different kinds of applications available on the MECC diskettes is shown. The software demonstrates applications in drill and practice, tutorial, simulation, problem solving, and worksheet generation. Samples from music, science, social studies, industrial arts, reading and mathematics are provided.

Elementary—Volume 1 (Mathematics)
MECC-702, $24.95

The first elementary diskette contains programs to be used in the elementary mathematics classroom. Games of logic such as BAGELS, TAXMAN and NUMBER, drill and practice programs, such as SPEED DRILL, ROUND, and CHANGE, and programs about the metric system such as METRIC ESTIMATE, METRIC LENGTH, and METRIC 21 are included on the diskette.

Elementary—Volume 2 (Language Arts)
MECC-703, $24.95

The teacher can enter lists of spelling words in the computer and have them used by the program SPELL, which drills students on the spelling, MIXUP which presents the word in mixed up order, or WORD FIND, which will create a word find puzzle for the teacher to duplicate. If words and definitions are entered, a CROSS WORD puzzle can be generated or a WORD GAME can be played. Two other programs included on this diskette are TALK, a program designed to introduce students to the computer or AMAZING which prints out worksheet mazes. Several programs on this diskette use a printer.

Elementary—Volume 3 (Social Studies)
MECC-704, $24.95

The sell series, SELL APPLES, SELL PLANTS, SELL LEMONADE and SELL BICYCLES which appears on the ELEMENTARY VOLUME 3 diskette can be used to teach elementary economics to students in grades 3-6. CIVIL will re-enact battles of the CIVIL war while STATES and STATES 2 provide drill and practice on the location of states in the U.S. and their capitals.

Elementary—Volume 4 (Mathematics And Science)
MECC-705, $24.95

Two mathematics programs ESTIMATE and MATHGAME provide reinforcement on estimating and basic facts. Food chains in fish can be studied through ODELL LAKE while ODELL WOODS deals with food chains in animals. SOLAR DISTANCE teaches the concepts of distances in space and URSA provides a tutorial on constellations.

Elementary—Volume 5 (Language Arts)
MECC-719, $24.95

ELEMENTARY—VOLUME 5 deals with the reading concept of prefixes. The diskette contains five lessons which both teach the prefixes of UN, RE, DIS, PRE, and IN. Two review drills, DRAGON FIRE and PRE-APP II, are also contained on the diskette.

Elementary—Volume 6 (Social Studies)
MECC-725, $24.95

Historical simulations, OREGON, VOYAGEUR and FURS are included in the ELEMENTARY—VOLUME 6 diskette. Along with these programs are NOMAD which teaches map reading and SUMER, a simulation of ancient Sumeria.

Special Needs—Volume 1 (Spelling)
MECC-727, $24.95

This diskette is designed to drill handicapped students on frequently misspelled primary and intermediate words. Students answer problems by either using the game buttons, the game paddles or any key on the keyboard.

Science—Volume 2 (Senior High)
MECC-709, $24.95

Many of the programs on this diskette were developed by Minnesota teachers. PEST, which deals with the use of pesticides, and CELL MEMBRANE, in which the user takes the part of a cell membrane, can be used in biology classes. SNELL plots light refraction demonstrating SNELL's law while COLLIDE simulates the collision between two bodies. Diffusion deals with the diffusion rates of various gasses. NUCLEAR SIMULATION shows radioactive decay of nine different radioisotopes, ICBM and RADAR teach angles and projections on a coordinate system.

Science—Volume 3 (Middle School)
MECC-707, $24.95

The FISH program through the use of low resolution graphics shows the circulatory system of a fish. Simulations like ODELL LAKE which is used to explore food chains, URSA which teaches about constellations, and QUAKES which simulates earthquakes are on the diskette. MINERALS can be used in the area of earth science to identify 29 minerals by having students perform simple tests.

Mathematics—Volume 1 (Senior High)
MECC-706, $24.95

BAGELS, SNARK, ICBM, and RADAR will teach students logic while reinforcing the concepts of plotting prints or angle measurements. ALGEBRA provides a drill and practice in solving equations. Three programs on the diskette can be used in plotting equations on a grid: SLOPE which is designed for use in ninth grade with linear functions, POLYGRAPH which will plot any equation on a rectangular coordinate system, and POLAR which graphs functions on polar coordinates.

Aestheometry—Volume 1
MECC-716, $24.95

Aestheometry teaches the topic of curves by viewing curves from two perspectives. The first method demonstrates the "space concepts" of elliptical, parabolic, and hyperbolic curves. Curve sketching designs are developed to provide an aesthetic view of geometric shapes. The second method uses a mathematical approach and defines a curve as the intersection of planes with a cone. The support booklet provides worksheets and classroom ideas.

Teacher Utilities—Volume 1
MECC-715, $24.95

The TEACHER UTILITIES diskette is designed to aid the teacher and would not be used by the student unless the teacher creates questions using the REVIEW program. This program allows the teacher to set up a list of questions which can be used either by the REVIEW program or the TEST GENERATOR program. The teacher can also make CROSSWORD puzzles, WORD FIND puzzles, BLOCK LETTER banners and POSTERS using this program. FREQUENCY and PERCENT can be used to calculate grades and to do statistical analysis. A printer is needed for some of the programs on this diskette.

Programmer's Aid—Volume 1
MECC-720, $32.95

The PROGRAMMER's AID diskette provides help for the programmer. Programs to be able to UPLOAD and DOWNLOAD to the MECC system, programs that work with text files including FP TO TEXT, RANDOM EDITOR, SEQUENTIAL EDITOR, and TEXT LIST along with programs to work with binary files, BINARY FILE INFO, BINARY FILE TO FP are included. Two programs TABLES and MERGE allow the user to create, change and merge graphic shapes for use in a program. FREE SPACE will tell the amount of space on the diskette while HIDDEN CHARACTERS will locate control character. STARTER will put standard routines such as space bar, music, graphic characters or input into a user's program which is just being created or already created.

MICAS—Volume 1 MECC-721, $49.95

Microcomputer Integrated Computerized Accounting System requires dual disks and 132 characters width printer. The MICAS computerized accounting system provides a realistic experience with automated accounting systems. The package consists of four integrated systems: (1) general ledger, (2) accounts payable, (3) accounts receivable, and (4) inventory control.

Shape Tables—Vol. 1 MECC-724, $24.95

The SHAPE TABLES diskette includes 12 files of 187 shapes than can be incorporated in a user's program. Also included are aids needed to work with shape tables.

Order Today—Prices effective through September 15, 1982.

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outpost : atari

David and Sandy Small

This column marks the one year anniversary for Sandy's and my series in *Creative*; we're looking forward to the next year and have a good deal to write about.

Usually we spend some time in a tutorial in these columns; this month we will discuss the Atari in terms of overall design philosophy.

This last year also marks a period of incredible growth for the Atari computer. The Atari Program Exchange got going and is now shipping a large volume of Atari software. This exchange provides low-cost but relatively high quality software written by outside users.

Last year at this time there was no *Jawbreakers, Asteroids,* or *Missile Command*; now these programs are being surpassed (Have you seen *Mouskattack* yet? The cover art alone is worth the purchase price.)

Last year we had the Basic and Assembler cartridges, neither of which was designed for speed or for large programs. Now we have Microsoft Basic, the awesome new Editor/Macro Assembler, Pilot, Forth, Lisp, and according to a letter I just received, Algol.

The tools to develop high quality software are now available; and it is a safe bet that more good software will be appearing on the market.

Outside manufacturers are also producing a wide variety of hardware for the Atari. There are several modems available, one of which I will review shortly (the direct-connect Microconnection).

David and Sandy Small, 11314 Yucca Drive, Austin, TX 78750.

There is also a good deal of hobbyist-oriented equipment, such as EPROM burners, I/O port connectors, and whatnot, and a light pen is now available from non-Atari sources.

Percom Corp. in Texas is now marketing an entire line of Atari-compatible single, double and quad density disk drives, and other companies have introduced Winchester drives. Atari has even published a list of outside vendors of software and hardware for their machine.

And did I mention the news that Atari has surpassed Apple in sales? And rumors of new Atari machines are currently flying (something may be announced in June, I am told). This machine is here to stay, and will continue to grow for quite some time.

What Is an Atari?

If you own an Atari, you may be curious to learn what you have bought. I searched long and hard for a definition of what Atari has produced; "home computer" is too vague. After all, it does have a specific and limited place in the market. For example Atari dropped the 815 double density dual disk drive when it did not conform to their definition of a "home computer."

The definition I finally found, is a "home computing appliance." Chew on those words for a while; they contain the essence of the design and marketing strategy of the Atari. This is a second-generation consumer-oriented machine, carefully designed and oriented towards the home market from the ground up.

Atari is not in the business market. They have no intention of competing with Tandy, Apple, and IBM, who are currently beating their respective heads together trying to capture that field. Atari stands with Texas Instruments in the home computer marketplace with a strategy of aiming at the home user.

Products designed for home use—principally games, home finance, and education/development—are released and pushed hard. Pilot offers a good example of the educational potential of this machine, and the games available for the Atari are becoming the standard for the home computer industry.

Bear in mind also that this is a consumer machine. It is not designed for a hardware or computer professional. It is designed for an average person who wants a "home computing appliance."

It is not as hardware oriented as the Apple. It doesn't have a collection of open "slots" on the various busses available. What housewife seeking help with her checkbook honestly cares whether or not she can access the interrupt request line with a plug-in card?

The layout is for a consumer. The machine is attractively styled, and goof-proof. Memory and the Operating System are packaged in cartridges located under the front cover, and joysticks plug in easily under the front keyboard.

Many of the programs available can be used by a consumer with little knowledge of computers; they plug in on ROM cartridges (most four-year old kids I know can master this trick), and the system Reset key is protected against accidental press, and so on.

SOFTWARE STREET

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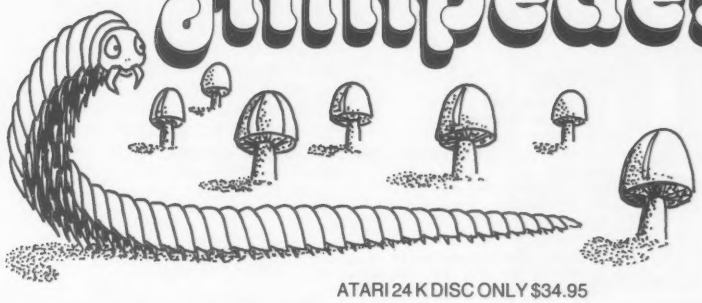

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I remember being told that "The Atari isn't a serious machine because it doesn't offer PASCAL." I have heard this sort of complaint many times, always directed at something the Atari lacked, be it Cobol, Fortran-1933, or whatever. The people who voice these objections (in most cases, computing professionals) don't understand that the Atari home computer is Atari's very serious attempt to make a computer that a home user can get along with—not necessarily a programmer, just a home user. It may not have the current languages that are in vogue today (and possibly gone tomorrow). But this is by design and not by default.

So, while the Atari may not at first glance *look* like a powerful computing machine, with lots of lights, integrated circuits, and cables all over the place, it is. It has just been designed for a home computer user according to Atari's idea of who the home computer user is.

Oh, and yes, Pascal is now available for the Atari.

GTIA Demonstration Programs

As of January 1982, Atari began shipping all Atari 800 units with GTIA graphics chips. The GTIA chip replaces the CTIA graphics chip and allows three more graphics modes. Don't worry, the operating system ROM and the Basic cartridge were written with GTIA in mind. GTIA is a superset of the CTIA functions.

Several short demonstration programs for the GTIA exist. I don't know where they were written, but I would assume somewhere at Atari by someone with a preliminary GTIA chip.

Below are several listings of sample GTIA programs. Users with CTIA graphics chips can try these programs, but don't expect spectacular results. Users with GTIA chips will be in for a pleasant surprise, indeed.

Feel free, as always, to modify them, and if you come up with a really neat effect, I'd appreciate a listing or a disk/tape (I'll return your disk/tape, of course.) The address appears at the beginning of the column.

By the way, if the author of these programs would care to step forward, I will certainly give him credit. I would like to know who wrote them. □

HYPNO

```
2 DIM A$(30)
3 GOSUB 30000
10 GRAPHICS 10
15 FOR I=1 TO 8:POKE 704+I,(I-1)*32+22:NEXT I
20 Q=1
30 FOR Y=0 TO 191
40 COLOR Q
50 PLOT 0,Y
60 DRAWTO 79,191-Y
70 Q=Q+0.416666666:IF Q>8 THEN Q=1
75 REM FOR T=1 TO 100:NEXT T
80 NEXT Y
120 Q=1
130 FOR X=79 TO 0 STEP -1
140 COLOR Q
150 PLOT X,0
160 DRAWTO 79-X,191
170 Q=Q+1:IF Q>8 THEN Q=1
180 NEXT X
190 REM COLOR 0:PLOT 0,0:DRAWTO 79,191:PLOT 79,0:DRAWTO 0,191
200 X=USR(ADR(A$))
210 FOR J=1 TO 4:NEXT J
220 GO TO 200
30000 REM *** SET UP ASSY PROGRAM
30010 RESTORE 31000
30020 FOR Z=1 TO 27
30030 READ X:A$(Z)=CHR$(X)
30040 NEXT Z
30050 RESTORE
30060 RETURN
```

LOGO

```
1 TRAP 80
2 DIM A$(30),SINE(450)
3 GOSUB 30000
4 DEG
10 GRAPHICS 10
15 FOR I=1 TO 8:READ A:POKE 704+I,I*16+6:NEXT I
20 COLR=1:Y=1
30 FOR X=10 TO 69
40 COLOR COLR
50 PLOT X,141-Y:DRAWTO X,191-Y
52 PLOT 79-X,141-Y:DRAWTO 79-X,191-Y
54 FOR Q=36 TO 43
55 PLOT Q,191-Y:DRAWTO Q,141-Y
56 NEXT Q
60 Y=Y*1.23
65 COLR=COLR+1:IF COLR>8 THEN COLR=1
70 NEXT X
80 X=USR(ADR(A$))
90 FOR J=1 TO 12:NEXT J
100 GO TO 80
1000 DATA 2,4,6,8,6,4,2,2
30000 REM *** SET UP ASSY PROGRAM
30010 RESTORE 31000
30020 FOR Z=1 TO 27
30030 READ X:A$(Z)=CHR$(X)
30040 NEXT Z
30050 RESTORE
30060 RETURN
```

ESCAPE

```
2 DIM A$(30)
3 GOSUB 30000
10 GRAPHICS 10
15 FOR I=1 TO 8:READ A:POKE 704+I,A+224:NEXT I
17 Q=1
20 FOR I=0 TO 38
40 COLOR Q
42 X=I
45 Y=I*2
50 PLOT X,Y
60 DRAWTO 79-X,Y:PLOT X,Y+1:DRAWTO 79-X,Y+1
62 DRAWTO 79-X,190-Y
64 DRAWTO X,190-Y:PLOT 79-X,190-Y+1:DRAWTO X,190-Y+1
66 DRAWTO X,Y
70 Q=Q+1:IF Q>8 THEN Q=1
80 NEXT I
100 X=USR(ADR(A$))
110 FOR J=1 TO 24:NEXT J
120 GO TO 100
1000 DATA 2,4,6,8,6,4,2,2
30000 REM *** SET UP ASSY PROGRAM
30010 RESTORE 31000
30020 FOR Z=1 TO 27
30030 READ X:A$(Z)=CHR$(X)
30040 NEXT Z
30050 RESTORE
30060 RETURN
```

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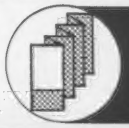

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CIRCLE 232 ON READER SERVICE CARD

MELONS

```
2 DIM A$(30),SINE(450)
3 GOSUB 30000
4 DEG
9 FOR I=0 TO 90:? I:A=SIN(I):SINE(I)=A:SINE(180-I)=A:SINE(180+I)=-A:SINE(360-I)=
-A:SINE(360+I)=A:NEXT I
10 GRAPHICS 10
15 RESTORE :FOR I=1 TO 8:READ A:POKE 704+I,A:NEXT I
18 FOR P=1 TO 2
20 Q=1
25 A=30
30 FOR ANG=180 TO 270 STEP 8
40 X=20*SINE(ANG+90)+25
50 Y=A*SINE(ANG)
55 Z=X:IF P=2 THEN Z=79-X
60 COLOR Q
65 IF ANG=180 THEN OLDX=Z:OLDY=Y
70 PLOT OLDX,96+OLDY
75 DRAWTO Z,96+Y
77 OLDX=Z:OLDY=Y
80 REM
90 NEXT ANG
95 Q=Q+1:IF Q>7 THEN Q=1
100 A=A-1
110 IF A>-30 THEN 30
200 FOR ANG=0 TO 180 STEP 10
210 COLOR 8
220 X=4*SINE(ANG+90)+25
225 Z=X:IF P=2 THEN Z=79-X
230 Y=30*SINE(ANG)
240 PLOT Z,96+Y
250 DRAWTO Z,96-Y
260 NEXT ANG
300 FOR I=1 TO 25
310 X=RND(0)*6+23
315 Z=X:IF P=2 THEN Z=79-X
320 Y=RND(0)*50+71
330 COLOR 0
340 PLOT Z,Y
350 NEXT I
400 NEXT P
900 REM X=USR(ADR(A$))
910 FOR J=1 TO 10:NEXT J
920 GO TO 900
1000 DATA 226,228,230,232,230,228,226,70
30000 REM *** SET UP ASSY PROGRAM
30010 RESTORE 31000
30020 FOR Z=1 TO 27
30030 READ X:A$(Z)=CHR$(X)
30040 NEXT Z
30050 RESTORE
30060 RETURN
```

ROLL

```
5 DEG
10 GRAPHICS 10
15 FOR I=0 TO 7:POKE 705+I,128+2:NEXT I
17 POKE 705,136
20 FOR ANG=180 TO 360+180 STEP 6
30 X=8+8*COS(ANG)
40 Y=16+8*SIN(ANG)
50 COLOR (ANG-180)/45+1:PLOT X,Y
60 DRAWTO X,50+Y
70 COLOR 0:PLOT X,Y
90 NEXT ANG
120 FOR ANG=180 TO 360+180 STEP 6
130 X=26+8*COS(ANG)
140 Y=16+8*SIN(ANG)
150 COLOR 9-(ANG-180)/45:PLOT X,Y
160 DRAWTO X,50+Y
170 COLOR 0:PLOT X,Y
190 NEXT ANG
220 FOR ANG=180 TO 360+180 STEP 6
230 X=44+8*COS(ANG)
240 Y=16+8*SIN(ANG)
250 COLOR (ANG-180)/45+1:PLOT X,Y
260 DRAWTO X,50+Y
270 COLOR 0:PLOT X,Y
290 NEXT ANG
320 FOR ANG=180 TO 360+180 STEP 6
330 X=62+8*COS(ANG)
340 Y=16+8*SIN(ANG)
350 COLOR 9-(ANG-180)/45:PLOT X,Y
360 DRAWTO X,50+Y
370 COLOR 0:PLOT X,Y
390 NEXT ANG
410 GO TO 500
420 FOR ANG=180 TO 360+180 STEP 6
430 X=50+8*COS(ANG)
440 Y=16+8*SIN(ANG)
450 COLOR (ANG-180)/45+1:PLOT X,Y
460 DRAWTO X,50+Y
470 COLOR 0:PLOT X,Y
490 NEXT ANG
500 A=PEEK(705)
510 FOR I=705 TO 711
520 POKE I,PEEK(I+1)
530 NEXT I
540 POKE 712,A
550 GO TO 500
```

SAS

```
2 DIM A$(30),SINE(450)
3 GOSUB 30000
4 DEG
8 ? "STAND BY"
9 FOR I=0 TO 90:? I:A=SIN(I):SINE(I)=A:SINE(180-I)=A:SINE(I+180)=-A:SINE(360-I)=
-A:SINE(I+360)=A:NEXT I
10 GRAPHICS 10
15 RESTORE :FOR I=1 TO 8:READ A:POKE 704+I,A+224:NEXT I
19 C=1
20 FOR ANG=0 TO 359
30 X=40+30*SINE(ANG+90)
40 Y=96+80*SINE(ANG)
50 COLOR INT(C)
60 PLOT 65,96
70 DRAWTO X,Y
75 PLOT 65,95
77 DRAWTO X,Y-1
78 PLOT 65,94
79 DRAWTO X,Y-2
80 Q=USR(ADR(A$))
85 C=C+0.5:IF C>=9 THEN C=1
90 NEXT ANG
900 Q=USR(ADR(A$))
910 FOR I=1 TO 14:NEXT I
920 GO TO 900
1000 DATA 2,4,6,8,6,4,2,2
30000 REM *** SET UP ASSY PROGRAM
30010 RESTORE 31000
30020 FOR Z=1 TO 27
30030 READ X:A$(Z)=CHR$(X)
30040 NEXT Z
30050 RESTORE
30060 RETURN
```

BRASS

```
10 GRAPHICS 9
15 SETCOLOR 4,15,0
20 FOR Y=55 TO 0 STEP -10
30 FOR X=0 TO 24
40 C=X:IF X>11 THEN C=24-X
45 C=C+3
50 Z=Y+(X)
55 D=INT(SQR(144-(X-12)*(X-12)))/2
57 COLOR 15-C
58 PLOT Z,Y+7-D
60 DRAWTO Z,Y+7+D
70 COLOR C
80 DRAWTO Z,180-Y+D
180 NEXT X
190 NEXT Y
200 GO TO 200
```

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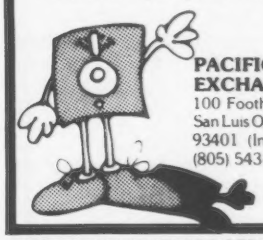

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CIRCLE 142 ON READER SERVICE CARD

Outpost: Atari, continued...

WHIRL

```
2 DIM A$(30),SINE(450)
3 GOSUB 30000
4 DEG
8 ? "STAND BY"
9 FOR I=0 TO 90:? I:A=SIN(I):SINE(I)=A:SINE(180-I)=A:SINE(I+180)=-A:SINE(360-I)=
-A:SINE(I+360)=A:NEXT I
10 GRAPHICS 10
15 RESTORE :FOR I=1 TO 8:READ A:POKE 704+I,A+224:NEXT I
17 GOSUB 2000
20 FOR ANG=0 TO 359 STEP 2
25 Q=8
30 X=20*SINE(ANG+90)+40
40 Y=20*SINE(ANG)+96
42 COLOR 0:PLOT X,Y:IF ANG<180 THEN 90
43 AS=0
45 FOR W=1 TO 45
50 LOCATE X,Y+W,QW:IF QW=0 THEN AS=1
55 IF AS=1 THEN 80
57 COLOR Q
60 PLOT X,Y+W
70 Q=Q-1:IF Q<1 THEN Q=8
80 NEXT W
90 NEXT ANG
95 Z=20:U=20
175 Q=Q+1:IF Q>8 THEN Q=1
900 X=USR(ADR(A$))
910 FOR I=1 TO 8:NEXT I
920 GO TO 900
1000 DATA 2,4,6,8,6,4,2,2
2000 REM THIS IS THE HEART OF DIZZY
2020 Q=1
2030 FOR Y=0 TO 191
2040 COLOR Q
2050 PLOT 0,Y
2060 DRAWTO 79,191-Y
2070 Q=Q+0.416666666:IF Q>8 THEN Q=1
2080 NEXT Y
2130 FOR X=79 TO 0 STEP -1
2140 COLOR Q
2150 PLOT X,0
2160 DRAWTO 79-X,191
2170 Q=Q+1:IF Q>8 THEN Q=1
2180 NEXT X
2230 RETURN
30000 REM *** SET UP ASSY PROGRAM
30010 RESTORE 31000
30020 FOR Z=1 TO 27
30030 READ X:A$(Z)=CHR$(X)
30040 NEXT Z
30050 RESTORE
30060 RETURN
```

RING

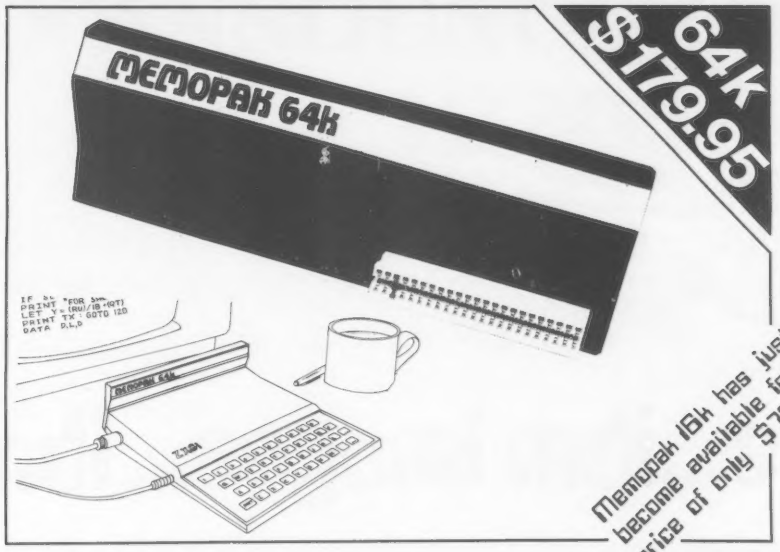
```
100 REM GTIA TEST
110 DIM C(22,2)
115 GRAPHICS 10:FOR Z=704 TO 712:READ R:POKE Z,R:NEXT Z
116 DATA 0,26,42,58,74,90,106,122,138,154
118 LIM=22:T2=3.14159*2/LIM
120 GOSUB 2500:FOR V=1 TO LIM:T=T+T2:GOSUB 2500:NEXT V
200 GOTO 1000
400 FOR X=1 TO 8:Z=PEEK(704+X):Z=Z+16:IF Z>255 THEN Z=26
420 POKE 704+X,Z:NEXT X:POKE 77,0:GOTO 400
1000 REM
1010 FOR R=1 TO 8:T6=R
1020 GOSUB 1520:NEXT R
1110 FOR R=9 TO 15:T6=16-R
1120 GOSUB 1520:NEXT R
1210 FOR R=16 TO 23:T6=R-15
1220 GOSUB 1520:NEXT R
1310 FOR R=24 TO 30:T6=31-R
1320 GOSUB 1520:NEXT R
1400 IF T3=1 THEN GOTO 400
1410 T3=1:GOTO 1010
1520 COLOR T6:V=0:GOSUB 2000:PLOT X,Y:FOR V=1 TO LIM:T=T+T2:
     GOSUB 2000:GOSUB 3000:DRAWTO X,Y:NEXT V:RETURN
2000 X=(30-R)*C(V,1)+40:Y=(60-R)*C(V,2)+80:RETURN
2500 C(V,1)=SIN(T):C(V,2)=COS(T):RETURN
3000 IF T3=1 THEN IF (R=1 AND V>11) OR R>1 THEN POSITION
     X,Y:POKE 765,T6:XIO 18, #6,0,0,"S:"
3010 RETURN
```

RAINBOW

```
100 REM GTIA TEST
115 GRAPHICS 10:FOR Z=704 TO 712:READ R:POKE Z,R:NEXT Z
116 DATA 0,26,42,58,74,90,106,122,138,154
130 FOR X=1 TO 8:COLOR X:POKE 765,X
140 PLOT X*4+5,0:DRAWTO X*4+5,159:PLOT X*4+1,159:POSITION X*4+1,0:XIO 18,#6,0,0,
"S:"
150 NEXT X
230 FOR X=8 TO 15:COLOR 16-X:POKE 765,16-X
240 PLOT X*4+5,0:DRAWTO X*4+5,159:PLOT X*4+1,159:POSITION X*4+1,0:XIO 18,#6,0,0,
"S:"
250 NEXT X
300 COLOR 0:PLOT 65,159:DRAWTO 0,159
400 FOR X=1 TO 8:Z=PEEK(704+X):Z=Z+16:IF Z>255 THEN Z=26
420 POKE 704+X,Z:NEXT X:FOR Y=1 TO 5:NEXT Y:GOTO 400
```

BALL

```
100 REM GTIA TEST
115 DIM C(8):GRAPHICS 10:FOR Z=704 TO 712:READ R:R=R*16+8:C(Z-704)=R:POKE Z,R:NE
XT Z
116 DATA -.5,1,3,4,5,7,9,12,13
118 LIM=22:T2=3.14159*2/LIM:COL=3:E1=1:DIM D(LIM,2)
120 GOSUB 1500:FOR V=1 TO LIM:T=T+T2:GOSUB 1500:NEXT V
400 GOTO 1000
490 REG=705
500 FOR X=1 TO 8:POKE REG,C(X):REG=REG+1:IF REG>712 THEN REG=705
510 NEXT X:REG=REG+1:IF REG>712 THEN REG=705
520 POKE 77,0:GOTO 500
1000 REM
1005 FOR E=1 TO 10:E2=INT(E/2-0.5)
1010 FOR R=E1 TO E1+E2:CR=8-COL:IF CR=0 THEN CR=8
1015 V=0:COLOR CR:GOSUB 2000:PLOT X,Y
1020 FOR V=1 TO LIM:T=T+T2:GOSUB 2000:DRAWTO X,Y:IF V>=LIM/2 THEN COLOR COL
1025 NEXT V:NEXT R:COL=COL+1:IF COL=9 THEN COL=1
1030 E1=E1+INT(E/2+0.5):NEXT E
1200 GOTO 490
1500 D(V,1)=SIN(T):D(V,2)=COS(T):RETURN
2000 X=(30-R)*0.6*D(V,1)+40:Y=60*D(V,2)+80:RETURN
```



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CIRCLE 268 ON READER SERVICE CARD

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Will Fastie

When I finally sit down to write this column, usually only milliseconds away from my deadline, I don't necessarily know what the theme will be. I know, I know, I promised displays this month. My intention was to fill the column with technical details about the IBM display technology. But a combination of letters from readers and some brief thought of my own has changed my mind.

The only thing that the letters from my readers have in common is that they don't have anything in common. Until this month, that is, during which several of them asked precisely the same thing: How can a graphics screen be dumped to an Epson MX100 printer?

Now that may seem like a very technical question, requiring much detail. But what do you really have to know in order to accomplish this? If you have your MX100 technical manual and your IBM Basic manual, you have all the information you need to write the program.

The people who wrote simply need that tip, and maybe a little example to get them started. They don't need to know how the graphics card works, where the video memory is, or anything like that.

Then I suddenly realized that those owners who cared enough about the really low-level details of the IBM Personal Computer would invest in the Technical Reference Manual. At least, they should. Is there any reason for me to propagate those same details here?

You tell me. Tell me what's important to you, what you need to know, what you want to learn, and I'll try to accommodate. If it really is the deep technical detail, that's fine. For the moment, I'm assuming it isn't, and that you would rather hear about new developments and products, especially software.

Sooo...this month I have another collection of more or less independent topics *and* I even have something about displays.

Out on a Limb

Two questions I am frequently asked are: Which Personal Computer operating system will become dominant? And when will the 8087 become available? Let me indulge in some speculation.

There are three announced operating systems for the IBM Personal Computer. The only one available so far (press time) is IBM's DOS (aka MS-DOS or SB-86, equivalent (?) to 86-DOS). The UCSD P-system was due in April, and CP/M-86 has not yet been announced as an available product. I have heard some rumors that the Pick operating system will be available for the IBM, and many of us expect XENIX, from Microsoft, to pop up in the near to middle future.

The real question is which OS the owners of the computer will have. Software manufacturers will build their programs to fit whatever harness is the standard. (Schick makes razor blades that fit Gillette razors.) The standard will be whatever is most readily available, and it's hard to believe that anything other than IBM DOS will dominate, primarily because its price is only $40.

Marketing efforts by Microsoft and Lifeboat Associates increase the pressure. Lifeboat's decision to market SB-86 was surprising; as the world's leading supplier of CP/M software, CP/M-86 seems a more consistent choice for them.

The UCSD P-system from Softech Microsystems is, in my mind, a viable choice. Unlike CP/M-86, programs written in the P-system do not require the buyer of the software to own the operating system. The software routines required to make a P-system program operate correctly can be delivered directly to the customer.

The catch here is that a royalty for those "run-times" is required, and this will in turn mean that the price of software packages written in the P-system will be higher. As a result, the P-system, although attractive to the software developer for reasons of application portability, will only be practical for the more expensive applications.

CP/M-86, on the other hand, will suffer because of its higher price. No price has been announced, but I can't imagine that it will be $40. And if IBM DOS and CP/M-86 are compared, it rapidly becomes obvious that 95% of the applications could be handled with either system.

Not only that, a new add-in device has been announced for the IBM which makes CP/M-80 (that's right, the 8-bit CP/M) available on the Personal Computer (see below). There will be some pressure for CP/M-86 from software suppliers writing

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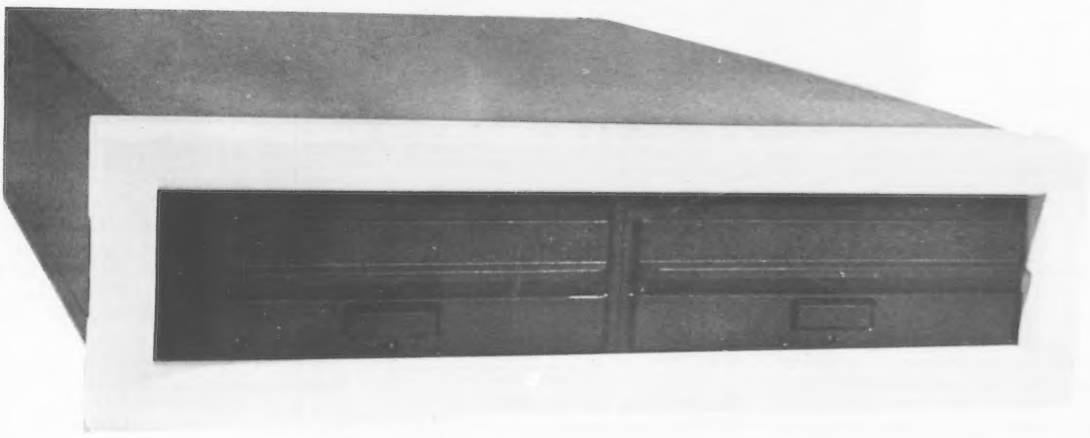

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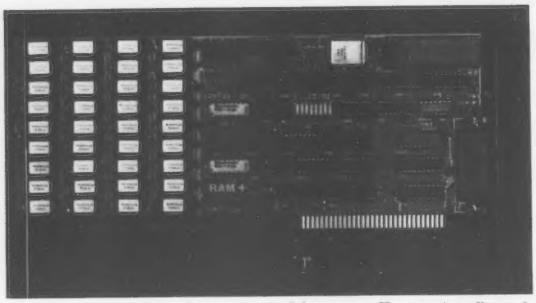

Photo 1a. Seattle Computer Memory Expansion Board.

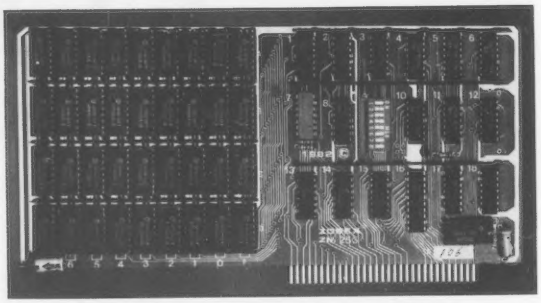

Photo 1b. Zobex Memory Expansion Board.

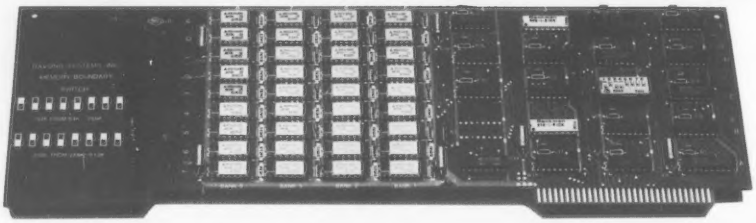

Photo 1c. Davong Systems Memory Expansion Board.

in Compiler Systems' CBasic because it is not available in IBM DOS, but I don't know how much market pressure this represents. I have been told the number of programs is significant.

As for the Intel 8087 Numerics Processor, I just don't know. My pet theory is that IBM will announce an upgrade for existing machines that will include the 8087 and a new set of ROMs with both a BIOS and a Basic that know how to take advantage of the power of the 8087. That might be followed by upgrades to the other language systems, and VisiCalc could be a big beneficiary.

How real is this? Beats me. Even though I have compared the system board schematics with the 8087 data sheet and verified that the pinouts are the same, IBM has nothing—absolutely nothing—to say on the subject. We can only assume IBM knew what they were doing when they mounted that extra socket on the board.

The Infamous Slot Guide

Remember when I complained because there weren't guides in all the options slots in the system unit? And remember my discovery that one of my display boards was warping? I finally got satisfaction.

IBM in Boca Raton (thank you, Jeanette) sent along a "Card Support Guide," IBM part number 8529156. IBM said that from now on, the guide would be packaged with cards that are long enough to benefit from one. The guides can be ordered from IBM in Greencastle, IN, or through your local dealer.

Once my guide was installed, I found it much more difficult to insert the adapter card. However, the board is supported very well now, which was the original objective.

Memory Expansion Boards

I have mentioned memory boards before because I think they are important products for the IBM Personal Computer. The obvious reason is the expanded function that can be obtained, particularly with VisiCalc (I think version 2 is now available from VisiCorp (nee Personal Software)), but also with Basic and the Macro Assembler. IBM Pascal, of course, requires the memory expansion.

A less obvious reason is the concern that the IBM memory board is inherently less reliable, something that several dealers have mentioned to me, but which is difficult for me to validate. The best reason is that all these memory boards offer four times the capacity of the IBM board, occupy only one slot, and use less power.

I have learned of several more boards. Photo 1a shows the board from Seattle Computer, 1b shows Zobex's offering, and 1c the Davong Systems product. Other boards are available from AST Research, and CRC Personal Computer Products.

The Seattle board is the most interesting because it includes not only 64 to 256K of memory but also one RS-232 serial port. So far, this is the most creative board I have encountered. The port is claimed to be compatible with the IBM port except that it does not include the current loop option.

The smallest board, with 64K RAM and the port, costs $475, and includes 27 empty sockets for expansion kit RAM chips. The largest board is 256K and costs $1075. A dealer friend of mine has certified the board and is selling it, and says the quality is good. (He thinks the Datamac board has the best quality.) I certainly rate this board a "slotsaver."

The Zobex board is a 256K board for $998. I know little more than that. Zobex claims that a unique addressing scheme allows each 64K segment on the board to be addressed individually, allowing each segment to be physically located at any 64K-byte boundary in the memory space.

Davong sells their 64K board for $395, 192K for $845, and 256K for $1075. Their press release did not say whether the board included parity, but the photograph shows four rows of nine chips each, which means that parity is there. Davong boards are interesting for price at the low end, as are the Quadram boards I mentioned last month, but I would check with them to see if parity is an option or not.

AST Research offers a 64K board for $495, 128K for $745, 192K for $995, and

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256K for $1145. The board supports parity, and they also offer a 64K upgrade kit for $145. Note that the 64K board plus upgrades is less expensive than the assembled version. I have found this to be true from most vendors. You have to decide whether you are willing to bypass the vendor's checkout procedure. The AST product brochure has a nice touch—it is sized to fit in IBM-sized binders, and is even punched.

CRC Personal Computer Products offers 64K to 256K boards in 64K increments priced from $488 to $1336. They also offer a smaller board starting with 16K bytes at $261 and ending with 64K at $433 in 16K increments. Their ad said "parity available," which made me think it was optional. I haven't talked with them yet.

Covers!

Some time ago I mentioned that the lack of covers for the computer was a serious problem. Three companies have emerged with products.

The first is TecMar, the company that also makes a long list of devices for the IBM Personal, including the only expansion chassis that I know of. Their covers come in a set with four pieces. There is a keyboard cover, a printer cover, a display and system unit cover, and a cover for the TecMar expansion chassis that can also fit a system unit. The set costs $42. They are made of translucent vinyl plastic.

The second company is CompuCover, which manufactures covers and has over 300 items in their product line. They make five different covers: keyboard ($7.95), system unit ($12.95), Monochrome Display ($9.95), system unit plus display (one cover, $15.95), and printer ($9.95). A set consisting of the keyboard and combination system unit/display covers sells for $19.95. The covers are made of cloth-backed vinyl and are available in either saddle tan or black. Robert Helms, President of CompuCover, told me that the covers are highly anti-static and very strong, and would last longer than the computer.

The third company is Cover Craft. I haven't seen their covers yet, so I can't comment.

The big reason to be concerned about anti-static materials is that they attract less dust. So far, my CompuCover covers have stayed relatively dust-free while the TecMar covers have collected enough to show a trace if I swipe them with my finger. Some dust has collected inside the TecMar covers. Either set has kept my system much cleaner than it previously was.

Both sets of covers seem to be constructed reasonably well. The TecMar system unit and display cover fits very well, but the keyboard cover doesn't. The CompuCover covers fit well, especially the keyboard cover which is like a glove, but the system unit and display cover combination does not have a full back. Although this is okay from the standpoint of protection (it's the disk drive that needs the cover most), a snug fit is not possible. Bob Helms said CompuCover would change the cover pattern if they had enough requests, but that so far he had received no complaints.

Software

Software for the IBM Personal Computer is beginning to appear. I don't think I will regularly list everything I find out about, but there is so little now that I can afford to. Most of what I know comes from press releases, so I can't vouch for anything yet. As I get some of these packages I'll relay my impressions.

I should first mention a tool. A company named Telecon Systems has developed a C language compiler for the IBM. They have apparently developed a C family which can run in RT-11, RSX-11, SDOS, FLEX, and CP/M and generate code for PDP-11, 8080/8085/Z80, and 6809 instruction sets. The IBM version runs in a 64K IBM DOS environment. The compiler emits assembly language source code, so an assembler for the target machine is required. Telecon claims compatibility with UNIX V7 and the Kernighan/Ritchie "standard" description ("The C Programming Language"). The compiler costs $350 and the object code can be sold without royalty obligation to Telecon.

This brings up an interesting point. At press time, no one I know had received a copy of the IBM Macro Assembler. IBM announced the program for February, and I have to admit that as I write, it is still February. Just barely, though, so it does appear that IBM is having some trouble getting its software out. I don't really understand why.

Interesting because the first vertical package I have seen is Ampersand Corporation's Branchbanker IRA Marketing Module. The program enables financial institutions to produce various Individual Retirement Account projections and analyses, and is designed to be used during face-to-face interviews with potential IRA customers. Ampersand sells a complete hardware and software configuration for $4600; I did not get the price for just the software.

Westico, The Software Express Service, has announced two products. The first is called ASCOM, and is a communications program for "users who need to interact with remote time sharing services or local computers to transfer data files and programs." The program has been available for other machines and was converted to the IBM. It costs $175. The other offering from Westico is MicroGANTT, a project planning system. I have no details. The price is $395, and the reference manual alone is $25.

Starware has announced the Mail Manager, a mailing system with sorting, selection, and printing features, which claims to be very friendly. The price is $49.

A data management system called TIM III has been announced by Innovative Software, Inc. It is the first piece of IBM Personal software I have actually seen from a third party software vendor, although I have yet to try the system. The price is $495.

Basic Business Software, Inc., has announced five packages. They sound very interesting—I'm going to try to get them. They are Common Basic Programs (76 programs from the Osborne book, $35); Finance Calculator ($30); Amortization and Depreciation ($30); Plotting ($75) which plots a file of data points on a printer; and IBM Basic Utilities ($75). This last includes a Basic cross reference program, printer program, mini-text editor, and subroutines for matrix manipulation, file searching, and others. If the cross reference program is any good, it could be worth $75.

Baby Blue

The most interesting announcement was made by a new company named Xedex on February 17. The device is called the Baby

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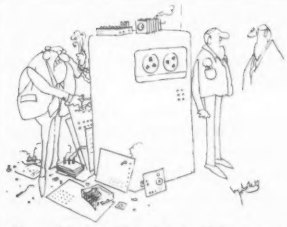

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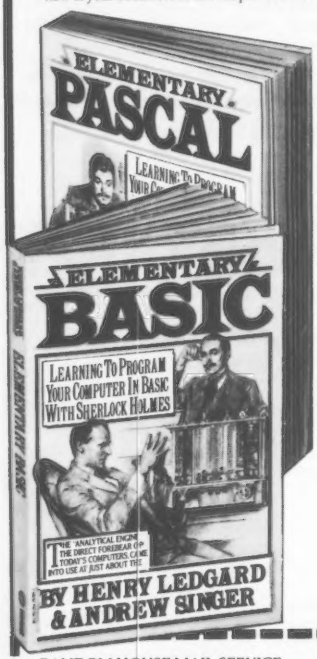
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Blue CPU Plus, and the product includes this device and some support software.

The product is an add-in CPU card for the IBM Personal. It includes a Z80B processor and 64K bytes of RAM. It enables the IBM to run standard CP/M-80 programs after they have been processed by a provided conversion program.

The conversion adds what Xedex refers to as a "header," after which the program can be placed on an IBM diskette where it appears to be an IBM-executable file. When it runs, however, the header moves the program into the memory space of the Z80 and initiates its execution there. The CP/M function calls are "translated" into IBM DOS calls, which are processed by the IBM 8088.

The best part of all is that the extra 64K bytes of RAM can be used by the Personal Computer as additional memory when the Z80 is not running. The product has a suggested retail of $600, which is only $60 more than the IBM 64 card! Very interesting.

I found out about this product just before my deadline, and I haven't had a chance to talk with the firm. It's high on my agenda, though, because it's a very clever and exciting concept. Xedex stated in the press release that they expect to sell 60,000 units in the 12-month period after product introducion, scheduled for April. 60,000! I wondered about that, but then I read an industry report that estimated that Microsoft's Z80 Softcard is responsible for 20% of all Apple II sales. Given the dearth of software for the IBM right now, I expect Xedex may have a tiger on their hands.

GTCO Digitizer

Most of the products I mention in this column have a consumer, commercial, or educational appeal. Very few have what I would call a professional or technical application. The first exception is a digitizer, the Datatizer from GTCO Corporation.

GTCO is the inventor of the "electromagnetic absolute ranging" digitizer, a technology said to provide high resolution at low cost. The cost is out of range for a consumer, though, which is why I think GTCO appeals to a professional engineering audience.

A digitizer with a surface size of 11" x 11" is $1419, while the 20" x 20" model costs $3025. The significance of the GTCO offering is that the price includes Personal Computer software that can be used for various kinds of measurements. The press release gives the following five examples: material usage; material cost; length, distance, perimeter; area of irregular polygon; display XY coordinates to .001 inches.

The IBM PC configuration must include 64K RAM, at least one disk drive, DOS and Advanced Basic, and an asynchronous communications adapter to connect the digitizer.

Retailing

I have mentioned before that there were very few IBM Product Centers. There still aren't that many by Computerland standards, but the number is growing. The list of cities with Product Centers is San Francisco, CA; Philadelphia, PA; Baltimore, MD; Columbus, OH; Orlando, FL; Washington, D.C.; Los Angeles, CA: Beverly Hills, CA; Boston, MA; Sunnyvale, CA; Seattle, WA; Chicago, IL; and New York City. There are three in New York, located in Chase Manhattan Bank lobbies.

Sears announced that their pilot test of computer stores was successful, and as a result will open 45 new Business Systems Centers in the next year. This is something to watch.

It has been rumored that IBM will open new distribution channels this year, but IBM would not speculate on the matter when I asked directly.

I have also tried to find out just how many units have been sold to date. IBM will not comment on volumes. There is a published report that IBM ordered 225,000 CPU chips from Intel for delivery during 1982. Of course, no one seems to have the slightest idea how many they have already bought.

More rumor: that IBM had orders for 100,000 machines by the time 1981 ended; that IBM predicts 100,000 sold for the first half of 1982; that IBM projects 350,000 or more installed machines by the end of 1982.

That's a lot of machines. I just don't see how that many computers could move through the external distribution channels IBM currently has in place. A good number of them, maybe more than 50%, must be sold through IBM's direct marketing force. That means mostly in the Fortune 1000 companies. Even so, that is still an incredible number of systems.

IBM + Sears Does Compute

It has been reported in these pages that *Creative Computing*'s pioneering founder, the esteemed and highly regarded David Ahl, was not able to use his personal Sears credit card to buy the IBM Personal Computer in a Sears Business System Center. I had originally been told that Sears would accept the personal card. The official Sears position, stated in a letter to me, is that the Centers "...honor all regular Sears retail credit cards." The letter goes on to say that "It is also our policy, however, not to place merchandise purchased for business use on a consumer account." The letter explains that the Centers also offer Merchant Credit Accounts for qualified

businesses, and that Sears has introduced a special installment account specifically designed for the Business System Center.

One reader has written me to report that he used his Sears consumer account to purchase a system. A number have reported that Sears offered them that alternative. So what happened? It could have been a number of things, including credit ratings and limits, but it certainly was aggravating for Dave. I score the fight one point Ahl (it should have been a routine purchase) and one point Sears (Creative *did* get a machine, and on a Sears account at that).

Users Groups

I promised to mention users groups in the column. Here we go.

To my eye, the group that looks most interesting right now is IPCO, Inc., the IBM Personal Computer Owners Group, operating out of Pittsburgh. It was founded by Jim and Cindy Cookinham and Steve and Windy Hart. What I find interesting is the size and scope of the newsletter, called *IPCO Info*. The first was rather light, but okay. The second was 16 pages and very well done. From the first two newsletters, I get the clear impression that IPCO is working hard to become the pre-eminent national users group for the IBM Personal.

They are very busy—everybody I talk to seems to have heard of them. The second newsletter contains a call to local groups to contact IPCO and offers guidance on how to start one. U.S. membership is $15. IPCO, Inc., P.O. Box 10426, Pittsburgh, PA 15234.

Needless to say, I'm a member (in good standing so far) of the Greater Baltimore IBM Personal Computer User's Group. Initiated by Neil Gustafson and supported by my favorite local Computerland store, the group is embryonic but has published its first newsletter. No dues set yet. c/o Computerland, 1516 York Rd., Lutherville, MD 21093.

IBMicro, the IBM Personal Computer User Group of the Washington DC Area, has been formed. No newsletter yet, but they do have an electronic bulletin board that members with communications hardware can get to. IBMicro, 1414-C Wright Circle, Bolling AFB, Washington, DC 20336.

An informal group has been formed at California State at Fullerton. Three seniors in Computer Science are the founders. Contact Bob Martynec, 2633 E. La Palma, Apt. 8, Anaheim, CA 92806.

I did receive notice of a group formed in Philadelphia. However, it apparently is now affiliated with PACS, the Philadelphia Area Computer Society. The IBM information is carried as a column in the PACS newsletter. The IBM users distribute *IPCO Info* at their meetings. PACS, P.O. Box 1954, Philadelphia, PA 19105, dues $10.

Displays

Finally.

My letters have indicated quite a bit of confusion about the display technology available from the IBM. Here's a little clarification.

IBM offers two display adapters, that is, the electronic devices that interconnect the computer with a display device. The first is called the Monochrome Display and the Printer adapter. This device is specifically designed to connect the IBM Monochrome Display. Other direct drive monitors with a horizontal drive of 18Khz should work properly.

The adapter, however, does not support dot-addressable graphics. The only graphic images that can be displayed are those that can be built using the character set.

The Color/Graphics Adapter does allow graphics. It allows the connection of direct drive monitors, NTSC monitors, and televisions, any of which can be color or black and white. An RF Modulator is required to connect a TV. This adapter has precisely the same character set as the Monochrome Display Adapter, so software will operate correctly on both.

The difference between these two adapters, other than graphics, is that the Monochrome Adapter generates 7x9 characters in an 9x14 box, while the Color Adapter generates 7x7 characters in an 8x8 box. In addition, the Monochrome Display uses the P39 phosphor, which has a very high persistence.

The result on the Monochrome Display is highly readable, almost fully-formed characters with good separation (3 to 5 pixels) between lines. The characters from the Color Adapter are readable, but there

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is less space (only 1 pixel) between lines. A character with a descender touches a tall or capital letter immediately below.

All this means that the Monochrome Display, with its excellent presentation, is highly desirable for text-oriented applications, or situations demanding a great deal of viewing, while the Color Adapter is required for graphic display applications.

A final note. The quality of text display on a device attached to the Color Adapter is solely dependent upon the display device. A reader from Garland, TX writes that a comfortable format on his Hitachi RGB color monitor is white characters on a blue background. If you are using the Color Adapter for text display, experiment with your display before you buy it to make sure you can stare at it for long periods.

Both Adapters At Once

One thing that is not explained well in IBM documentation nor understood clearly by most is how to deal with a system in which both display adapters have been installed.

The first thing to know is how to set the switches on the system board to indicate the dual display. This is stated in both the Guide to Operations and the Technical Reference. Switch 1 should have positions 5 and 6 set to OFF. This is the setting that means either the Monochrome adapter *or* both adapters. This setting causes the Monochrome Display to be the "default" display. That, in turn, raises the question "how is the Color Adapter engaged?"

That is the vital piece of information which is not mentioned anywhere in IBM manuals. On page 4-176 of the Basic manual there is an example of how to use the PEEK function. The example shows how to test location &H410 and determine which adapter is installed, but it cannot determine if *both* are installed.

Location 410 is called the "equipment flag" and is initially set by reading the switches on the system board. The test in the example program, reproduced here in Listing 1, is simply looking for a switch configuration indicating that the Monochrome Display is installed. Note that it examines the switches—you could pull out your Monochrome Adapter and the switches would still say "It's there."

The program in Listing 2 actually determines the presence of the display adapters. It does so by POKEing a value into the memory contained on the adapters, and reading it back. If the value is the same, the adapter is there. If the value is different, the adapter is not.

Listing 3 is my adaptation of the program "B" and "C" from the IBM Dealer Demo disk. These are the two Basic routines that know how to switch between displays. You will note that they modify the contents of location 410. This gives the appearance that only one device is installed.

The rest of the sequence in each subroutine is required to cause the BIOS routines to initialize properly for the desired display.

I wanted to change them so that I could get at one display without destroying the other, but I could not find a combination that worked. One reason is that the BIOS only keeps one set of records—when you switch displays you clobber the previous data.

To accomplish simultaneous display you must write a program that does all the bookkeeping. During my experiments, I would write to Color, switch to Monochrome, write there, but discover that my cursor position was where it had been left on Color, the Monochrome cursor having been lost.

Next month: Your guess is as good as mine. If I can get the information, I'll have a graphics screen to MX-80(G) or MX-100 dump program. □

Listing 1. Program to read equipment flag switches.

```
10 ' Program to test which display adapter is on the system
20 ' Will Fastie  - 28 Feb 82
30 ' Adapted from page 4-176 of the IBM BASIC manual
40 ' Note:  Program cannot determine if BOTH adapters are present!
50 ' IBMMONO is 0 if color adapter is found, 1 if monochrome adapter
60 DEF SEG = 0
70 IF (PEEK(&H410) AND &H30) = &H30
     THEN IBMMONO=1: PRINT "Monochrome";
     ELSE IBMMONO=0: PRINT "Color/Graphics";
80 PRINT " adapter found."
90 END
```

Listing 2. Program to determine precise display adapter configuration.

```
100 ' Program to test which display adapter is on the system
110 ' Will Fastie  - 28 Feb 82
120 ' An original work, I guess
130 ' Note:  Program CAN determine if both adapters are present!
140 TRUE = -1
150 FALSE = NOT TRUE
160 MONSEGADR = &HB000
170 CGASEGADR = &HB800
180 ' Is the Monochrome adapter there?
190 DEF SEG = MONSEGADR
200 PRINT "Monochrome memory:       ";
210 GOSUB 270
220 ' Is the Color/Graphics adapter there?
230 DEF SEG = CGASEGADR
240 PRINT "Color/Graphics memory:   ";
250 GOSUB 270
260 END
270 ' Subroutine to test the first location in the memory segment
280 ' and indicate found or not
290 ' Memory location tested is restored to original value.
300 ' Two tests are made with different values.
310 MEMLOCACTIVE = FALSE
320 ORIGVAL = PEEK(0)
330 ' test 1
340 TESTVAL = &H0: GOSUB 410
350 ' test 2
360 TESTVAL = &HFF: GOSUB 410
370 ' print result
380 IF MEMLOCACTIVE THEN PRINT "FOUND!" ELSE PRINT "not in system."
390 POKE 0,ORIGVAL
400 RETURN
410 ' Subroutine to test location - sets MEMLOCACTIVE if test is positive
420 POKE 0,TESTVAL
430 TRIALVAL = PEEK(0)
440 IF TRIALVAL = TESTVAL THEN MEMLOCACTIVE = TRUE
450 RETURN
```

Listing 3. Subroutine to initialize to specified display adapter.

```
65500 REM DISPSUBR - subroutines to switch displays
65501 REM Enter here with DISPCODE set to 1 for Mono, 2 for CGA
65502 IF 1 > DISPCODE AND DISPCODE > 2 THEN STOP
65503 ON DISPCODE GOTO 65520, 65510
65504 STOP
65510 REM DISPC - Simple program to setup Color/Graphics Display
65511 REM       - from IBM's "C" program on Dealer Demo
65512 KEY OFF: CLS
65513 WIDTH 80: DEF SEG=0: A=PEEK(&H410): POKE &H410,(A AND &HCF) OR &H20
65514 WIDTH  40 :SCREEN 1: SCREEN 0: LOCATE ,,1,6,7: SCREEN 0,0,0
65515 RETURN
65520 REM DISPM - Simple program to setup Monochrome Display
65521 REM       - from IBM's "B" program on Dealer Demo
65522 KEY OFF: CLS
65523 WIDTH 40: DEF SEG=0: A=PEEK(&H410): POKE &H410,A OR &H30
65524 WIDTH  80: LOCATE ,,1,12,13: SCREEN 0,0,0
65525 RETURN
```

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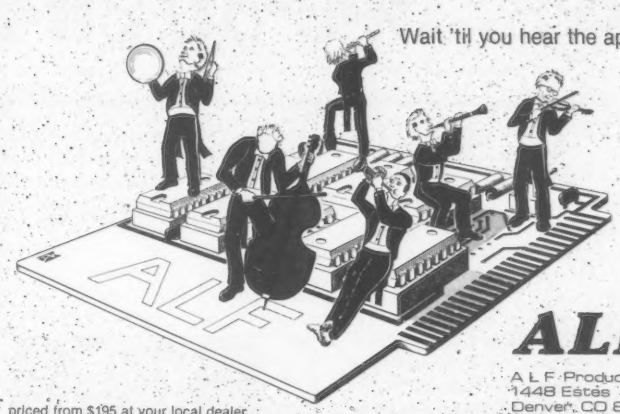

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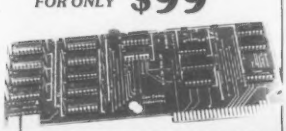

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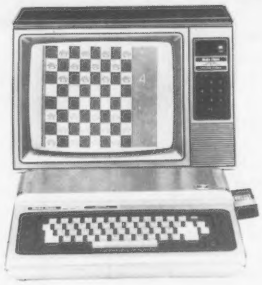

rings...trs-80 strings...trs-8

Stephen Gray

At 41 minutes past the hour on the TRS-80 clock, we pause for a look at Radio Shack's new Model 16 and PC-2 computers, four-color PC-2 printer/plotter, and DT-1 video terminal, ask a question about the TRS-80's skin, revisit the programming of blank lines, check out Disk Scripsit, read praise of Scripsit, read a complaint about a CLOAD game, look at new games by Leo Christopherson and Hayden, and check out a short program with a surprise ending.

Very early this year, I asked somebody in Radio Shack management about rumors regarding a new computer. He said he didn't know about any new computers. Several weeks later, on January 19, 1982, Radio Shack introduced two computers and a terminal, but they weren't really all-new; they were very much based on previous TRS-80 products, so my friend hadn't really exaggerated....

TRS-80 Model 16

Take a TRS-80 Model II, replace the 8-bit Z-80A with a 16-bit microprocessor, replace the single 8" single-sided disk drive with one or two "thin-line" 8" double-sided disk drives, raise the maximum internal RAM storage space from 64K to 512K, add multi-user capability to the operating system, change the black keytops to white and vice-versa, and you've pretty much got a TRS-80 Model 16. In fact, you can upgrade a Model II to a Model 16.

The Model II uses one Z-80A for the keyboard, the other for the video. The Model 16 uses a Z-80A for input/output, but for a main processor uses a Motorola

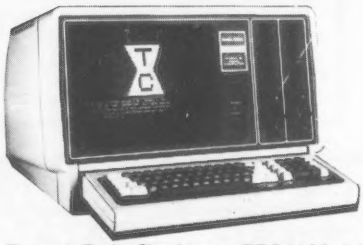

Figure 1. Radio Shack's new TRS-80 Model 16 uses a Motorola 16-bit microprocessor and is compatible with the Model II.

MC68000, which allows the 16 to access more memory than the Z-80A does. Also, because the data path of the 16 is 16 bits wide, and because the MC68000 can perform 32-bit operations internally, the new computer can process more complex data and at higher speeds. The MC68000, by the way, is a generation newer than the Motorola 6809E used in the Color Computer.

The single built-in disk drive in the Model II stores 416,000 characters. The TRS-80 Model 16 comes in two basic versions, both with 128K of RAM: single drive, 1¼ megabytes of storage, at $4999; two drives for a 2½-megabyte capacity, $5798. That's three (or six) times the internal-disk capacity of the Model II, and four times as much RAM as the basic one-drive 32K Model II that sells for $3450.

The multi-user feature permits adding one or two local or remote terminals (such as the new DT-1 described later) so that up to three people can use the computer at the same time.

Upgrading a Model II to a 16

The Model II is upward-compatible with the Model 16, meaning Model II programs will run on the 16, but not always vice-versa. Like the Model II, the 16, through one of its serial ports, is capable of bisynchronous communications with IBM and other mainframes. Adding a hard-disk port permits using up to four of Radio Shack's 8.4-megabyte Winchester-type hard disk drives.

A Model 16 Enhancement Option consists of two plug-in boards that provide the Model II with the 16-bit, dual-processor, multi-user features of the Model 16, for $1499 (plus installation). The Model II's disk drive and display remain unchanged in this upgrade.

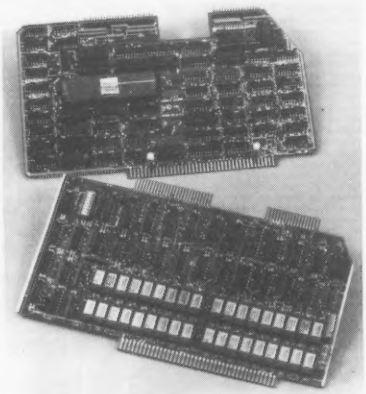

Figure 2. These two plug-in boards upgrade a TRS-80 Model II to a Model 16, giving the user 16-bit, dual-processor, multi-user operation.

The TRS-80 Model 16 is aimed at sophisticated corporate users. It is compatible with Radio Shack's ARCNET local network (based on Datapoint Corp.'s ARC network), which supports up to 255 Model II and 16 computers in any combination, and which is due in mid-1982.

TRS-80 DT-1 Video Terminal

Replace the dual disk drives of a TRS-80 Model III with a single cover, change the display from 16 lines of 64 characters to 24 lines of 80 characters, change the microprocessor, and you've pretty much got Radio Shack's DT-1 Video Data Terminal. The price is $699, which coincidentally is the price of a 4K Model III without disk drives.

Figure 3. Radio Shack's DT-1 video data terminal, based on the TRS-80 Model III, is designed for multi-user applications of the Model 16 and as a time-sharing remote terminal.

The DT-1 can emulate the protocols of four standard terminals—Televideo 910, Lear-Siegler ADM-5, ADDS 25, Hazeltine 1410—with configurations selected from the keyboard, and will maintain a protocol despite power failures through the use of an EEPROM (Electrically Erasable Programmable Read-Only Memory).

The display provides normal, reverse, invisible, blinking, underlined and half-intensity video, along with four types of keyboard-selected cursors: steady or blinking, block or underline.

The DT-1 has both parallel and RS-232C serial interfaces enabled as printer ports by a local-monitor mode that also can position the video cursor using local-control and escape modes. Ten keyboard-selectable baud rates, from 75 to 19,200, are available. An electronic bell is standard.

PC-2 Pocket Computer

At first glance, the new PC-2 Pocket Computer looks very much like the older model that Radio Shack may eventually call the PC-1. But look closer and you'll see several differences in the PC-2, which is list-priced at $279.95.

The new display is 26 characters long instead of 24, and has both uppercase and lowercase characters. The typewriter-style keyboard still uses the QWERTY layout, but the 13 shift-mode characters (dollar-sign, up-arrow, etc.) have all been relocated and three more have been added: square-root, ampersand and @. Also added are six function keys; in addition, the PC-2 has 18 "soft keys" and 10 pre-programmed command keys.

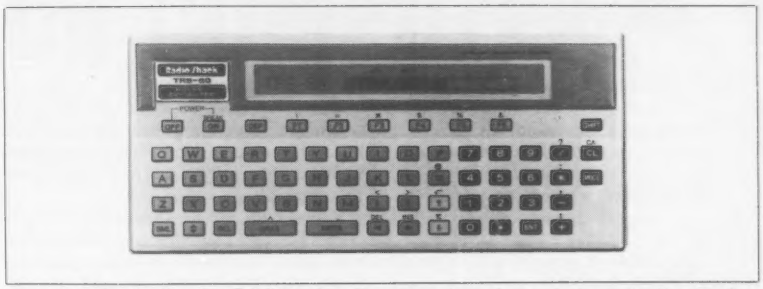

Figure 4. Radio Shack's PC-2 Pocket Computer is a close cousin to its first Pocket Computer; but the memory can be expanded internally.

However, the *big* differences are that the PC-2's memory can be expanded internally, it can be expanded externally through a 60-pin I/O connector, it uses Extended Basic, and it will be usable as a terminal.

A $69.95 4K RAM module plugs into a recessed port on the back of the PC-2; up to 16K of RAM and/or ROM may be plugged in. (Plug-in ROM-based programs may thus be in the offing.) The standard PC-2 memory consists of 16K bytes of system ROM and 2640 bytes of user memory (1850 bytes of Basic program and data RAM, 600 bytes of fixed data memory, and 190 bytes of reserve memory).

The PC-2's Extended Basic has 42 statements, 34 functions and 6 commands, and includes two-dimensional arrays, variable-length strings up to 80 characters long, and string-handling commands such as LEFT$, LEN, VAL and CHR$. A built-in real-time quartz clock is accessible from the keyboard or from Basic.

A fully-addressable LCD dot-matrix display of 7 by 156 dots permits generating special user-definable characters.

Late in 1982, Radio Shack plans to introduce an RS-232C interface and software that will let the PC-2 be used as a terminal with many RS-232C-equipped computers and peripherals, as well as providing connection to Radio Shack's modems for data communications over ordinary telephone lines.

The PC-2 Pocket Computer, according to Radio Shack, has "advanced capabilities" that "open up a great many application areas, including engineering, scientific and medical calculations; banking, credit, insurance, investment and financial applications...its capabilities are closer to a desktop computer than any previous pocket computer, yet it costs much less than typical desk top personal computers."

The PC-2's Extended Basic is upward-compatible with TRS-80 Pocket Basic, so programs prepared for the "PC-1" will run on the PC-2.

PC-2 Four-Color Printer/Plotter

A four-color printer that can plot graphics, plus a dual-cassette interface, comprise the PC-2 Pocket Computer Printer/Cassette Interface, available in mid-1982 at a list price of $239.95.

The printer/plotter adds 25 commands and statements to Pocket Extended Basic, including special statements for plotting 216-by-512-pixel graphics in red, blue, green and black with replaceable ballpoint pens, on 2¼" cash-register-type paper. Characters can be printed in nine different sizes, from 4 to 36 per line.

The "PC-1" is manufactured for Radio Shack by Sharp Corp., which markets it as the PC-1211 Pocket Computer. The PC-2 is also made by Sharp.

Aluminum Sprayed on Plastic

If you've used a TRS-80 awhile, and are in the habit of resting your hands on the plastic surrounding the keyboard, you've probably found that the aluminum color isn't molded into the plastic—it's sprayed on.

So what can you do to keep it from wearing off? If you cover the two places where your palms rest on the surround, then when you try to remove the tape later, you'll take off more aluminum paint than if you hadn't used the tape. Any solutions? And has anybody found a spray-on or brush-on paint that matches the TRS-80's aluminum color?

Blank Program Lines Revisited

From Washougal, WA, Delmar D. Hinrichs writes:

"You did it the hard way! In your column in the Jan. 1982 issue of *Creative* (p. 180), you suggest adding blank lines to programs by adding spaces until the cursor goes to the next line. This works, but there is a better way.

"Instead of adding spaces to the program line, use the ↓ (down-arrow) key. This puts a line-feed character, ASCII 10, into the program line. Besides requiring fewer key strokes, this method of adding blank lines has two real advantages:

1. Fewer bytes are added to the program (I always seem to be short of memory).

2. The program will list on a printer the same as it is displayed on the video display.

"This method of using ↓ may also be used to break long lines to make them easier to read. The ↓ may even be used within a long ON/GOTO, ON/GOSUB, or DATA statement to make it look better. For such long lines, it helps to add a space or two after the ↓ to indent the later part(s) of the line."

Delmar is right, but only for printers such as the Radio Shack Line Printer VIII. If you've got a printer like Radio Shack's Line Printer II, which is really the Centronics 730, you can add a dozen line-spaces with the down-arrow, and that printer will ignore them completely, and print, one after the other, the two lines you had hoped would be separated by two inches of space. With the II/730 and others like it, you must add spaces the hard way: one at a time.

Disk Scripsit

Radio Shack's Disk Scripsit is almost exactly like cassette Scripsit (June 1980, p. 166), with only a few small differences. One is price: the Model I/III disk version of this word-processing program is $99.95; on cassette, for 16K Level II or Model III Basic, it's $39.95.

The manuals for the two Scripsits are almost identical, except where they involve loading the program. Also, the disk manual includes a page on "Helpful DOS Instructions," half a page on "Using Scripsit in Conjunction with Basic" (save all Basic files in ASCII format), additional error messages, and 2½ pages on "How to Modify Scripsit for Use With Special Printers" (with assembly-language routines), plus two addendum sheets that say, among other things, that the Scripsit disk "can be backed up or copied only twice" (really??).

You get the same three audio tapes with both versions, with six lessons that guide you through what, as the cover indicates, is actually more of a training guide than a manual. This makes it difficult for you to look up anything later; there's no index. So you usually have to depend on the Instruction Summary Card, which is very handy if you use Scripsit often enough for the summarized material to be meaningful.

All these differences aside; if you're writing anything more than a few pages long, Disk Scripsit is the way to go. If you've got a 16K TRS-80 and cassette Scripsit, you can keyboard only about 3½ double-spaced pages of text before the memory is full, and you have to save it on tape before you can add any more.

With Disk Scripsit, you can enter over 100 double-spaced pages on one 5¼" disk, and move paragraphs around much more easily than on tape, where it is cumbersome to move material from one recorded section to another.

Some of the features that make Scripsit such a pleasure to use include global search and replace, text centering, page numbering, hyphenation help, headers and footers, and justified margins.

In Praise of Scripsit

The following letter is from George Brubaker, a research associate in the Department of Chemistry at Wayne State University, who has a TRS-80 with a low serial number:

"I have followed your column since its inception (this is SN 7727 running Scripsit, the real point of my letter), and find it to be an excellent focus for those of us who are TRS-80 devotees as well as newcomers who are comparison-shopping.

"I've often been asked why I am such a devoted TRS-80 fan. Frankly, for two reasons, which might be worth restating in your column.

"1. This is the most reliable computer I have ever used. Obviously, it is old. It has never been serviced because of a failure. It has been 'lowercased' and it has had the keyboard replaced (after three years of full-time service), both by Radio Shack, and both times with a turnaround of 30 hours or less. In comparison, we are still trying to find reliable and fast service for our Apples (which need a great deal of service) and our PETs (which don't, but when they do....). *Service*, then, is a key point in Tandy's favor (at least in metropolitan Chicago, our full-time home).

"You'll find 'Running Business Efficiently Without A Computer' on the fiction shelf..."

"2. Scripsit is a nice word-processor, which has been reviewed several times. But in each review, a key point was missed, a point which also bears heavily on the overall utility of the TRS-80 computer. That is, Scripsit, Basic and Fortran can read and write common *full ASCII files* (in contrast with the more common compressed ASCII used internally by most Basic interpreters). In essence, that means you can write and edit programs as well as letters using Scripsit provided that the Basic or Fortran program is saved from Scripsit using the ?S,A option.

"Programs written in Disk Basic and saved with

SAVE "name",A

may be loaded into Scripsit for editing (or formatted printing). If you've ever wanted to change one line number in Basic, or change every occurrence of a string in a Basic program, you already have justification for getting Scripsit.

"If you've used both Scripsit and EDIT80 in the Radio Shack Fortran package, you can appreciate the power of that 'A' option. Scripsit tabs can be set for Fortran programs (or Pascal, if you like 'prettyprint listings'), and a program may be written and edited just like a letter. You needn't worry about the line numbers EDIT80 puts in your program. Forget 'em, because the Fortran compiler doesn't want them; they are used only to guide the programmer and EDIT80."

Survivor

I've got a complaint against the *Survivor* game in the Jan. 1982 issue of CLOAD. There's not much problem getting away from a piranha, pterodactyl, giant squid, tyrannosaurus or even a zombie as you move toward the treasure. Even a ghoul can be evaded. But as the treasures increase in value, the monsters get closer...(gulp)... and closer. The wraith and the demon can sometimes be outwitted, but the witches—oh my, the witches!—they stay close, they breathe down your neck, ready to leap on you the second you stray from the safety barrier around the perimeter, just as you're heading for the $3500 gold nugget or the $2400 sapphire broach.

The game's author is a fiend, an absolute fiend. He lets the early easy wins lull you into a false sense of confidence, so you're easy prey to the Green Witch, if you get that far, which is doubtful. Author John Howard (may he spend the rest of his life in Cleveland, writing tic-tac-toe games) has made sure that long before you escape the ultimate horror, the Green Witch, and make off with a total of $101,000 in treasures, you will die of heart failure or go berserk. What's more, this fiendish Aussie (of Toorak, Victoria), had the unmitigated

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gall to write *Survivor*, not in machine language, but in Basic.

Voyage of the Valkyrie

One of Leo Christopherson's best thus far is *Voyage of the Valkyrie*, the first game from the Advanced Operating Systems division of Howard W. Sams & Co., and "available at computer stores nationwide" with a suggested list price of $34.95 for cassette, $39.95 for disk.

"As you move through the island of Flugloy," according to the press release, "you encounter bird-like creatures which fly around your CRT in an effort to protect their castle's treasure."

Your first job is a game in itself: map the island. Half a dozen double-sided gridsheets are supplied. You teletransport yourself from one location to another, often right into a solid object; you'll be destroyed many times in your mapping.

Some map locations are defended; you fire at the birds with a complex weapon. There are ten castles to be captured, each containing gold; your score is the amount of gold you have at the end.

A full description of Leo's game could take pages. There's Wagnerian music played (via an external amplifier and speaker) "at various appropriate times during the campaign," ten levels of difficulty (with about 60 birds to defeat at level 0, up to about 600 at level 9), different birds with differing weapons and fighting abilities, energy to replenish, a complex Status Report, and ranks that you climb as you capture more gold, from private to prince regent.

The 12-page manual is as colorful as it is complete, with a diagram of the keyboard that shows very clearly what each relevant key is for.

As usual with Leo's games, the graphics are superb, as are all the other facets. This is another of the handful of games that create high standards for others to aim at.

Mind Thrust

Described on the back of the 12-page manual as "The first of its kind—an exciting game that lets you match wits with the computer," this $16.95 tape for Level-II 16K TRS-80 from Hayden Book Co. doesn't quite match that claim.

For one thing, there *are* other games, more exciting, that let you match wits with the computer. The most recent one reviewed here is *Iago*, (Feb. 1982), Datasoft's version of *Othello*, and highly addictive.

For another, *Mind Thrust* involves just a little too much luck. It's an 8-by-6-square board game in which you try to "complete an unbroken chain across the playing board" to win. "The player takes turns at either adding a piece to his chain or attacking the opponent's chain to make it shorter."

When you are attacked, you announce which of your pieces you choose to defend. "If the point attacked is *not defended*, the piece in that square is replaced by an attacker's piece. All of the defender's pieces touching the attack point are removed from the board."

The catch is that skill plays very little part in deciding whether you are successful in defending your pieces; it is a random choice by the computer. If you like a mixture of "skill and luck" then perhaps you'll like this game, which has a "legalized cheating" feature: at any time you can switch sides with the computer. Any time you're about to lose, just switch and take over the winning side.

Short Program #30: Watch Close Now

Jeff Holman, a high-school senior in Monroe, NC, sent a short program that does something mysterious—if you don't know how it works.

"Our Sun Valley High School math club, of which I am a member, recently purchased a Level-II 4K TRS-80 for the members to use in their spare time. (We do not have data-processing classes.) It was not long before we started subscribing to *Creative Computing*.

"I have since written many programs (lately I have concentrated on those using graphics). Some that I am most proud of are a program that displays output alphanumeric characters as one-inch-high graphics characters as soon as the individual keys are hit (or twice the width if the SHIFT and right-arrow keys are hit) and an *Etch-A-Sketch* program that allows the user to draw pictures on the screen. When the picture is finished, the entire screen is 'saved' in a few strings that can be printed at any time. (It would be a lot easier if I knew how to use machine language!)

"I went off on a tangent with string-packing. Instead of poking graphics characters, a program I wrote pokes alphanumeric characters. This particular program is helpful when 'pictures' are stored in memory to be printed on a line printer. The characters can be typed on the screen to form the shapes desired as they are simultaneously 'packed' into successive strings.

"I have a zillion-and-one short programs I'd like to send in, but I'll just concentrate on one for his letter. I won't say what the program does (I love surprises!). The real 'meat' of the program is between lines 60 and 90; the rest is just to prepare the screen.

"I know it's a bit too slow for most programs, but I'll leave it up to your readers to 'juice it up.'"

```
10 CLS
20 FOR X=15360 TO 16384
30 POKE X,RND(64)+127
40 NEXT X
50 'OKAY—WATCH CLOSE NOW
60 FOR X=15360 TO 16384
70 XX=PEEK(X)
80 POKE X,191-(XX-128)
90 NEXT X
100 GOTO 100
```

If you have trouble figuring out how this works, change 16384 to 16383 in both places, and then ask yourself why the change makes a difference. If that doesn't help, look at the Level-II TRS-80 memory map in the Radio Shack manual. If you can write a very short program that produces the same effect as these ten lines, then you understand what's going on.

Line 80 reverses each displayed graphics character to its "negative" but only once. If you change 16384 to 16383 and change line 100 to

```
100 GOTO 60
```

the screen will alternate continuously between a display of graphics characters and their negatives. Changing line 100 to

```
100 GOTO  20
```

provides a different pair of positive/negative displays at each go-around.

NOTE: This short program works as described with Model-I Level-II Basic and with Model III Basic. Although with Model III Disk Basic, the "watch close now" effect isn't as dramatic, you may still have a problem figuring out what happened. □

"...I see you turned in your expense account on a Mobius strip, ...very funny..."

data base

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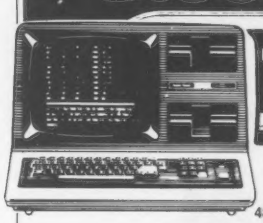

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Gregory Yob

A while ago, I took a look at the PET/CBM Personal Computer Guide which comes with each PET and discovered that the sections on using the PET disk drives were, to say the least, confused. In particular, the relations between Basic 3.0 ("new" ROMs), Basic 4.0, the model 2020 and model 4040 disk drives simply did not make any sense. So, let me try to light a small candle on the subject and see what's what.

To start with, the PET disk drive is an *independent* peripheral which talks with the PET via the IEEE 488 bus. The disk has its own computers—two of them: one to talk with the IEEE 4888 and one to talk to the disk drives—which handle all of the disk operations. The PET merely sends commands and data via the IEEE 488 bus. This situation is *very different* with other popular microcomputers.

Most personal computers handle their disk operations directly, i.e., all of the directory maintenance, file I/O, etc., goes through the computer. For example, if you had an Apple and told the machine to format a new disk, the Apple would be completely tied up while the disk was being formatted.

With the PET, you can tell the disk to do the formatting, and you can do some other operation while the disk drive formats the disk.

As far as the PET disk is concerned, the PET does not exist. The disk drive sees only the IEEE 488 bus. This leads to two very interesting consequences: first, more than one PET can share a disk drive—provided only one of them uses the disk at any time; second, *any* IEEE 488 compatible device can use the PET disk drive if the device can send the required commands over the IEEE bus.

The HP desktop computers, or even (heaven forbid) an Altair or North-Star S-100 computer with an IEEE 488 card could use the PET disk. Of course, some programming work would be required.

2020 vs. 4040

Now, about the 2020 vs. the 4040. The 2020 disk drives were the first disk drives made by Commodore. Several bugs exist in the model 2020, and the 4040 is essentially an upgraded version of the 2020. Disk DOS 1.0 and 2.0 refer usually to the 2020 disks, and DOS 2.1 refers to the 4040 disk. (Note: The 3030 disk is the 4040 adapted to European AC power.)

Now, please take note: *The PET disk model and DOS have no relation to Basic 3.0 or Basic 4.0.* If you still have the 2020 model disk, you can get it upgraded to the 4040 by a change of ROM chips. I *strongly* recommend that you do this.

Diskettes written by one model of the disk can be read by the other model but not written to. If I put a 2020 format diskette into my 4040, I can read the directory and files, but I cannot write to this diskette.

The reverse situation is also true—with a major catch. Your 2020 disk will try to write to the 4040 diskette and the result will be a mess. When you get a "wrong sex" diskette, use the COPY command to transfer the files to the "right sex" disk. You cannot DUPLICATE or BACKUP the "wrong sex" diskettes.

The 2020 disk drives are rather unintelligent concerning the insertion of new diskettes into the drives. If you put diskette A in, use it (which requires the "initialization" command), and then remove diskette A and insert diskette B, you are in danger. You must "initialize" again or the 2020 believes that diskette A is still there, and if you SAVE a file, diskette B gets rather smashed up.

The full explanation of this weird behavior would take most of a column, but here is a very brief summary: On each diskette there is stored a table which indicates where the unused sectors are. This is called the BAM map. When the 2020 "initializes," the BAM map is read from the diskette into the local memory of the 2020 (*not* the memory of your PET—the PET disks have their own RAM), and stored to make any write operations to the disk operate quickly. If the BAM weren't held in the memory of the disk drive, it would have to be read and written to the diskette many times. If you change the diskette without re-initializing it, a future write

Figure 1. Basic 4.0 Disk Commands and Their IEEE 488 Equivalents.

All Basic 4.0 commands can be replaced by their equivalent IEEE 488 command. The IEEE 488 commands which use PRINT# assume that OPEN 1,8,15 was performed earlier. For other variations on the commands than the single example shown, consult your disk or Basic 4.0 manual. The U option in Basic 4.0 means a different IEEE device number is used in the disk open statement. For example, INITIALIZE D1 ON U7 implies OPEN 1,7,15 followed by PRINT#1, "11".

Basic 4.0	IEEE 488
INITIALIZE D1	PRINT#1,"I1"
HEADER "NEWDISK",D0,INO	PRINT#1,"N0:NEWDISK,NO"
CATALOG D1 or DIRECTORY D1	LOAD "$1",8 followed by LIST
BACKUP D0 TO D1	PRINT#1,"D1=0" (note reverse order)
COPY D1 TO D0	PRINT#1,"C0=1" (note reverse order)
COPY "AFILE",D0 TO "BFILE",D1	PRINT#1,"C1:BFILE=0:AFILE"
COLLECT D0	PRINT#1,"V0"
DSAVE "TURTLE",D1	SAVE "1:TURTLE",8 (three examples
DSAVE "TURTLE",D0,R	SAVE "@0:TURTLE",8 given here to
DSAVE "TURTLE",D1,U7	SAVE "1:TURTLE",7 show variations)
DLOAD "FISH",D1	LOAD "1:FISH",8
RENAME "TURKEY",D0 TO "FOWL"	PRINT#1,"R0:FOWL=TURKEY"
SCRATCH "FOO*",D1	PRINT#1,"S1:FOO*"
CONCAT "XTRA",D0 TO "SOME",D1	PRINT#1,"C1:SOME=1:SOME,0:XTRA"
DOPEN#3,"ELDATA",D1,W	OPEN3,8,2,"1:ELDATA,SEQ,WRITE" (It's up to you to
DOPEN#4,"RNDATA",D1,L25	OPEN4,8,3,"1:RNDATA,REL,L"+CHR$(25) maintain the secondary
DCLOSE#5	CLOSE 5 addresses)
RECORD#3,300,47	PRINT#1,"P"+CHR$(SA)+CHR$(44)+CHR$(1)+CHR$(47)

The functions shown below are not BASIC 4.0 commands and must be done in the IEEE 488 format:

(The value SA is the secondary address that the file was opened to. 44 and 1 represents the number 300 in low-hi format.)

Open Data file to add more sequential data.	OPEN5,8,2,"ELDATA,SEQ,A"
Change Unit Address from 8 to 7.	PRINT#1,"M-W"CHR$(12)CHR$(0)CHR$(2)CHR$(39)CHR$(71) (39 and 71 are 32+7 and 64+7 respectively)
Verify program DRIVER on drive 0.	VERIFY "0:DRIVER",8

The advanced disk commands B-R,M-W, etc., must be performed in the IEEE 488 form. See your Commodore Disk manual for further information on these. If you look at the TEST/DEMO disk programs you can glean some information which is not in your manual. Happy hunting.

operation will use the BAM map of the first disk to write onto the second disk whose BAM is entirely different. The only possible result is a disaster for your second diskette.

The 4040 disk drives circumvent this problem by looking at the "disk ID" which is a two-byte quantity written onto *each sector* of the diskette. When a disk operation is attempted, the ID found on the diskette is compared with the ID last seen. If they are different, the BAM map is read and the change of diskette is detected.

However, sometimes you can't win. When a diskette is duplicated by DUPLICATE or BACKUP, the disk ID is duplicated also. If diskettes A and B have the same ID, the problem remains, for the 4040 still doesn't recognize that the diskettes are different. If only Commodore had looked at the disk drive door and put a switch there. . .

(Note for 2020 users: if you SAVE a program and then VERIFY it, the BAM map is automatically updated. This also cures the "replace file" bug whose causes are similar in origin. SAVE "@0 :FOOFILE" followed by VERIFY "0 :FOOFILE" re-initializes your disks.)

Basic 3.0 vs. Basic 4.0

Now, let's tackle Basic 3.0 vs. Basic 4.0. First, the reason you get "new" ROMs when you buy a disk drive (provided you had the "original" ROMs) is that the early PET ROM set had a fatal bug in the IEEE 488 software. (The IEEE 488 ATN line was always TRUE in LOAD and SAVE, preventing any data transfers on the bus, so programs couldn't be moved from PET to disk or vice versa. Data files work fine on the IEEE 488 bus for all PETs.)

Basic 3.0 (sometimes called Basic 2.0 or the "new" ROMs) is merely the original PET basic with several major bugs fixed. Your PET sees all IEEE 488 operations as files, and aside from LOAD and SAVE, all communications with the PET disk are conducted as data file operations. This, of course, is *incredibly clumsy*. (We do get used to *anything* in this field, however strange it may be.)

So, in Basic 3.0 we have the rituals of OPEN, PRINT# and CLOSE. To add to the delight, the PET disk drives use Secondary Address 15 as the "command channel," which means that you must OPEN n,8,15 to issue commands to the disk drive. If you OPEN n,8, (some other number), you are sending data to the disk (not commands).

So, in short, your PET opens a file which is in your PET to talk to the IEEE 488 bus. Then your PET sends characters on the IEEE bus which are seen by the disk. Depending on the Secondary Address (provided by the PET as directed by your OPENing the file), the disk will see either commands or data. The disk maintains its own *separate* set of file descriptions and does the required operations.

When your PET sees a CLOSE file operation, this is sent on to the disk, which then changes its set of file descriptions. Can you see what's coming?

If you never CLOSE a file in the PET—say you interrupted a program, loaded another program which used different file numbers, etc., and ran it—the disk will leave its version of the file still OPEN.

If you have troubles with losing files, the three major gotchas are:

1. Failure to re-initialize after inserting each new diskette—2020 users only.

2. Inserting a diskette with the same ID as the previous one. (By the way, changing the ID in the directory does *not* change the ID in the sectors.)

3. Failure to CLOSE all files when done with disk operations. This one is hard to detect, for OPENing the same file or secondary address will supercede the prior OPENing and you will not be wiped out—the PET disks are considerate about this.

The final blow with Basic 3.0 is that the diskette directories are usually LOADed into the PET and then LISTed to be seen. The price is that your current Basic program is destroyed in the process. (The filename "$0" is a valid one and you can read it as a sequential file with the GET# statement. What you will see is not easily explained without a disk manual nearby, however.)

The "Wedge" or DOS Support program was created to eliminate the rituals of OPEN and PRINT# for most disk operations. When the PET is running the Wedge program and you enter a "wedge" command, the PET's file OPEN and PRINT operations are not performed. Instead, the internal ROM routines which communicate with the IEEE 488 bus are activated directly by the Wedge program. The result is that the PET disks see *exactly the same characters on the IEEE 488 bus* and they respond identically. The Wedge also intercepts incoming characters from the disk and in some cases (like the directory) places them on the screen instead of destroying your Basic program.

If you are using the Wedge, you can still use the old style OPEN, PRINT# and CLOSE commands for the disk if you want to. The PET disks will not know the difference.

Basic 4.0 has incorporated several commands, such as CATALOG and DSAVE which act in a manner very similar to the Wedge program. When a Basic 4.0 disk command is executed, the same character sequences are sent to the PET disks as with the OPEN and PRINT#, and like the Wedge, the file system is kept unaware of most of the Basic 4.0 commands. (DOPEN and DCLOSE are, of course, seen as files by the PET.)

So, the versions of the PET disk, 2020, 4040, Old and New DOS, or versions 1.0, 2.0, and 2.1 all refer to the features found in the disk drives. These have no relation to the versions of PET Basic. The PET disks only see the IEEE 488 bus and any IEEE 488 device could, in theory, use the PET disks.

The PET Basics and the Wedge programs each have different ways for the

user to issue disk commands. However, the actual commands sent to the IEEE 488 bus for a given command will be *identical* regardless of the version of PET Basic used.

Figure 1 shows the relationship between the Basic 4.0 and IEEE (i.e., OPEN & PRINT#) forms of the PET disk commands. Note that some of these do not usually appear in the Commodore manuals. If you are writing Basic programs to work for all PET models, you must use the IEEE 488 file form of the disk commands, i.e., the OPEN and PRINT# rituals.

Don Ross Rebuts

In the previous column (Feb. '82) I reviewed some educational programs by Don Ross. Here is his letter in reply.

Dear Mr. Yob:

Your recent comments concerning my math programs never mentioned (good or bad) their educational value, only some minor programming points. A review of my program *Long Division* in *The Computing Teacher,* Vol. 8, No. 2, stated "I think this program should be in every classroom where arithmetic remediation is going on."

I am enclosing a copy of this review. Please note that it was written by an educator.—Don Ross

I do not have space to reprint the other review, but I will send a copy to anyone who is interested.

IEEE 488 Extension Card

When I bought my Comprint 912 printer, the interface consisted of a ribbon cable without a connector. I had to get an edge connector and wire it up myself. Later, I got the disks, and along with the disks came the PET to IEEE cable. Unfortunately, my Comprint cable didn't have the standard IEEE connector, so I had to make a choice: printer or disk, but not both. The solution was to build a little card with one female edge connector and two card edges to permit the use of both cables. Figure 2 shows the construction of this extension card.

If you build this widget, be patient and do it carefully. All 24 connections must be brought out and wired. Use the female connector to measure the male card edges to fit precisely.

Two More Utility ROMs

In an earlier column (Feb. '81) I mentioned the Disk-O-Pro ROM provided by Skyles Electric Works which upgrades a Basic 3.0 ("new" ROMs) to the Basic 4.0 disk commands and adds a few other features. Several other ROMs have appeared which help you in your struggle with the disk and the PET in general. Each of these has some nice features—and some overlaps. I dream of a 1M ROM which has *all* the nice features I like. . . . Meanwhile, here are two to think about.

XDOS By Prominico

The XDOS 2.2 ROM (Prominico, 1921 Burrard St., Vancouver, BC, Canada V6J 3H3. $97.50) provides the Wedge (Dos Support) program in ROM form and a few nice features for helping you select programs for copying and loading from a diskette. The ROM is available at all three ROM addresses, $9000, $A000 and $B000, so you can select the one that fits your empty sockets. Once you start with the appropriate SYS address, XDOS provides the Wedge—so you no longer have to do LOAD"*", 8 and RUN—less 500 or so bytes of memory.

Several "menu" commands read the diskette directory and build a form on the screen with the filenames and the selection letters 0-9 and A-Z. Up to 36 filenames will appear in the form. If you press the space bar, the menu will show the next 36 filenames and so on, returning to the first 36 when all of the files have been displayed.

Pressing the appropriate select key lets you load, copy, or scratch files depending on the type of menu you asked for. MENU is for loading and running programs, and does not list the SEQ or REL files. DMENU only shows the data files. SMENU shows all files, and you can select the files to scratch by pressing their selection letter. RETURN then scratches the files. CMENU assists neatly with the tedium of copying only selected files from one disk to another. (This command is almost worth the price of the chip.)

Several printer utilities complete XDOS. Pressing SHIFT RVS * together will dump the contents of the screen to a Commodore printer. This can be enabled as required. You can also send data to the printer from a direct command by prefacing it with an asterisk, which is handy in debugging work. XDOS also re-initializes the disk after SAVE or SAVE REPLACE which makes life simpler for 2020 disk owners.

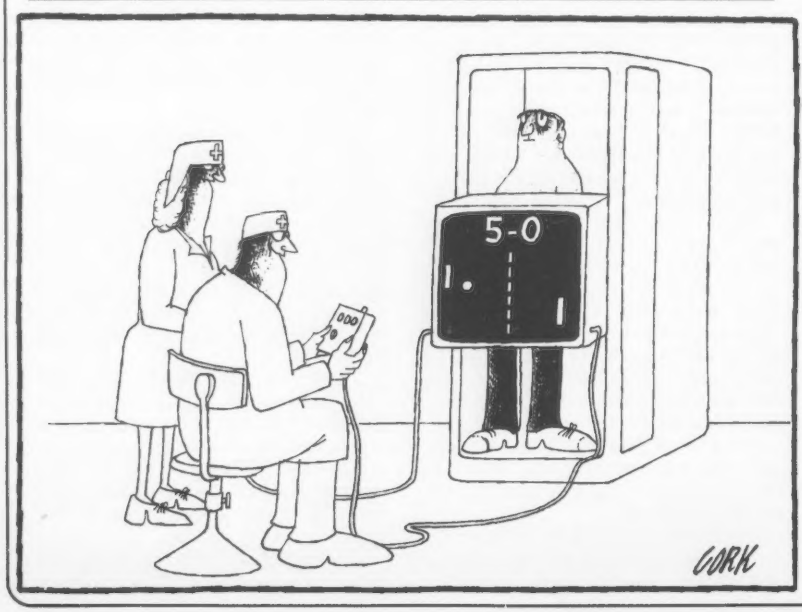
I like XDOS, but feel that its price is a bit high. Prominico also has a ROM for sorting which I haven't had a chance to review.

The +20 ROM

The English PET users are an active source of neat things, as any reader of *printout*! (P.O. Box 48, Newbury, England, RG16 0BD. $29 per year) will know. The +20 ROM (Grove House, Holwick St, Alnwick, Northumberland, England) is priced at about $100, and provides 22 commands which assist with many "housekeeping" tasks that must otherwise be tediously programmed in Basic.

Seven of the commands provide the disk directory, initialization, program load, load and run, program merge, and file opening functions. Other commands flash the screen, reverse the color of the screen, scroll up and down, turn the repeat key function on or off, control the STOP key action (on or off) and convert PETASCII to ASCII for your printer.

Also provided are some rather unusual commands. There is a provision to allow the ← symbol to be used for INPUT just as the ? serves for PRINT, a sort for string arrays, and a "screen input" which lets you specify the row and column on the screen to input a given number of characters—useful in "form filling" business applications.



I found most of the +20 commands to work, with the glaring exception of the formatting command (which set its array to all zeroes, wiping out any data that was present), and the commands to enable/disable the stop key (which did nothing). All of the commands were sensitive to spaces; in most cases you can't put a space between a command and its arguments.

All in all, I find that I prefer functions to look at least superficially similar to Basic commands (I have written two major sets of Basic extensions which do exactly that) and learning condensed commands that don't "fit" the Basic style is a bit awkward. Unfortunately, the price is about 1.5K of machine language and ROM space is precious, so the program writer must choose between style and features. If you need the functions provided in these two ROMs, get them, but be sure your needs are real.

Hex To Decimal Infinitum

Just as the Eight Queens problem is always found in a recursive language manual (i.e., Forth, Pascal, Sail) our lowly Basic programmers like to do Wumpus (fine with me) and Hex-to-Decimal conversion. Back in the October 1980 column I published this short program by David Harris:

```
10 G=16:A$="0123456789ABCDEF"
20 INPUTH$:FORI=1 TOLEN (H$):
   FOR J=1TOG: IFMID$ (H$,I,1)
   =MID$(A$,J,1) THEN C=C*G+J-1
30 NEXT J, I:PRINTC:C=0:GOTO20
```

John Brereton and Rober Baker changed Line 30 to:

```
30 NEXT:NEXT:PRINTC:RUN
```

which saved 6 bytes. Frank Levinson got it down to 78 bytes:

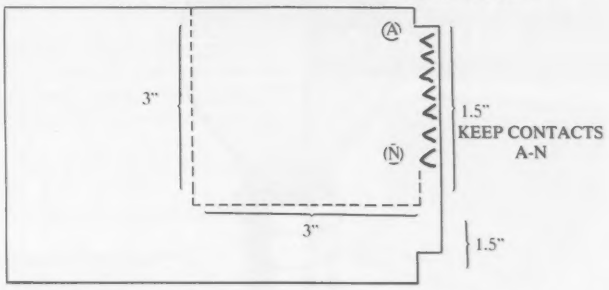
```
10 INPUTH$
20 C=C+ASC(H$)-48+7*(H$ >"9")
30 H$=MID$(H$,2):1 FLEN(H$)THEN
   C=C*16:GOTO20
40 PRINTC:RUN
```

Very nice. Now, no more copycatting on three-line programs. Any more Hex/Decimal programs will result in my asking *Creative Computing* to cancel your subscription. Let's see some *new* ideas!

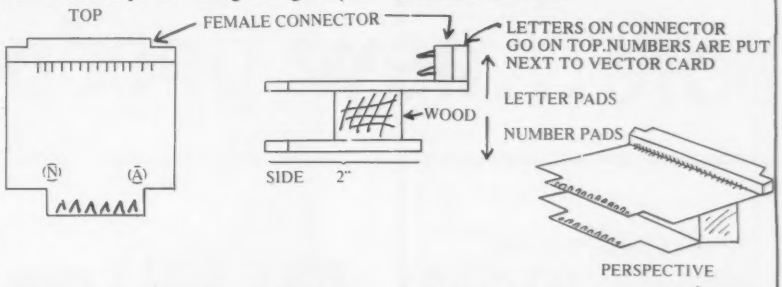
The Nuclear PET

Ivan Smith's PET Nuclear Power Plant, which appeared in the August '81 issue of *Creative Computing* is quite a nice program. It is lots of fun to play with, and like many simulations, you can do reasonably well on the third try, but there's always room for improvement in your performance. Ivan has put the program into the public domain. If you want a copy, send me both a tape and SASE.

Take one edge connector which fits on the PET (That's a 12-position 24-contact connector on .156 centers—AMP 530655-3 7932) and two Vector 6″ ×4″ prototyping cards with 22 positions/44 contacts on the card edge. Using a hacksaw (or tinsnips with great care), cut away the excess card as shown below:



After cutting both Vector cards, remove the six traces PADS P,R,S,13,14 & 15 on the left side of each card by heating them with a soldering iron and pulling away with needle nosed pliers. Using hot glue (or epoxy) and a small block of wood, build the assembly as shown below. Take care to leave enough room on both sides of the wood block to allow for the wiring and insertion into the PET.



Prepare 24 wires with the insulation stripped to 1/4″ on one end and 1 1/4″ on the other end. I used the solid wire used for telephone work as it is easy to handle; 24 AWG solid core wire will do nicely. Insert the 1 1/4″ stripped wires into the holes A-N on the upper card and the remaining wires in the row above to fit with holes 1–12 on the other side of the card. Be sure the wire passes through the corresponding holes in both cards. Once the wires are inserted, use a good quality electronic soldering iron (and much patience) to solder the wires at their corresponding pads on both cards. Take care to avoid short circuits. Then solder the other end of each wire to the corresponding pins on the female connector. Note that the orientation of the cards and the connector is critical to the success of this project. □

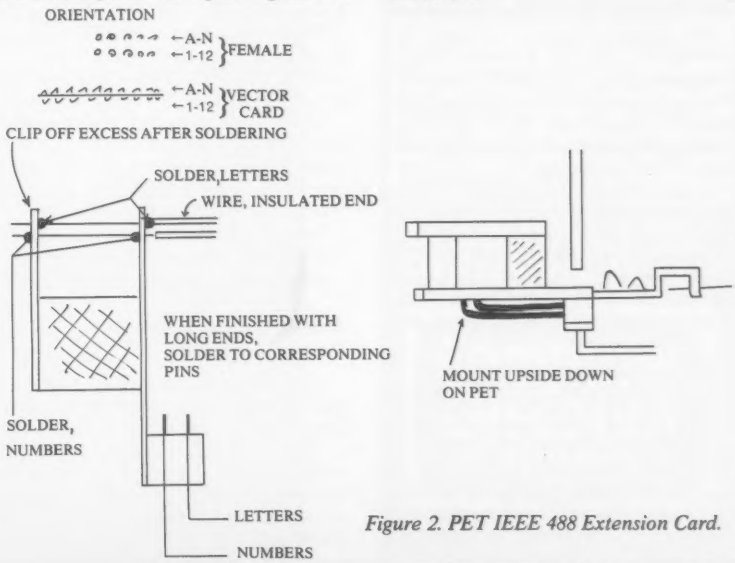
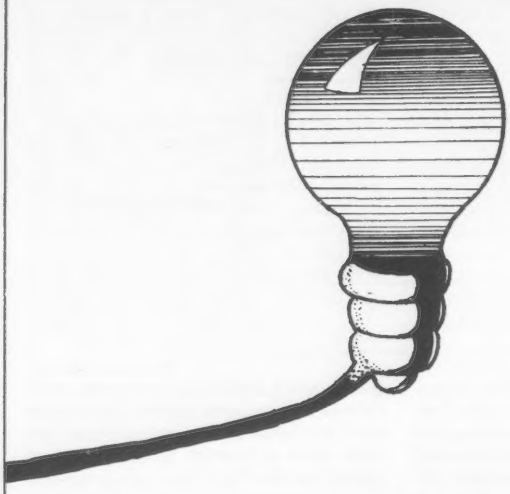


Figure 2. PET IEEE 488 Extension Card.



ucts...new products...new

Three Business Systems

Information Support Systems, Inc. announces Voyager, a desktop microcomputer with a 64K RAM processor. The system comes with a fully integrated Business System and Word Processing Package programmable in Basic and Pascal, with CP/M capabilities.

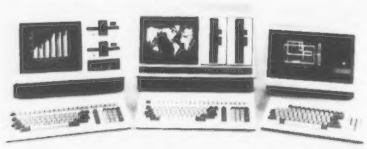
Voyager II is a 2 MB, dual floppy system, and Voyager III is a 6 MB hard disk system. All are priced under $9995.

Information Support Systems, Inc., 2049 Century Park, E, Ste. 2095, Los Angeles, CA 90067. (800) 235-3561, (213) 552-1820.

CIRCLE 300 ON READER SERVICE CARD

Desktop Business Computers

Sanyo Business Systems Corporation has introduced three desktop business computers. All will be supplied with CP/M, Sanyo Basic, Diagnostics and Utilities. All units have business graphics capability, detachable keyboard, number pad, cursor control keys, programmable functions keys



and a green phosphor, high impact, nonglare CRT display screen.

The single 5 1/4" disk drive model FDS-1000 will have the add-on capability of three additional disk drives for a total of 1Mb. The MBC-2000 incorporates two 328K drives and has the additional capability of two more drives for a total of 1.3Mb. The MBC-3000 offers two 1Mb drives with add-ons for a total of 4Mb.

All three machines are supplied standard with 64K of RAM memory. The FDS-1000 is built around a Z-80A microprocessor, and the MBC-2000 and MBC-3000 use the 8085A CPU.

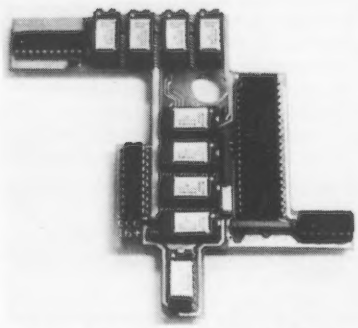
Sanyo Business Systems Corporation, 51 Joseph St., Moonachie, NJ 07074.

CIRCLE 301 ON READER SERVICE CARD

Memory Expansion for Color Computer

Computerware has introduced a board that expands the memory of the Radio Shack Color Computer from 16K to 32K.

The 16 Plus Board does not require soldering, and fits under the RF shield cover inside the computer. Complete installation instructions are included with the board.



Design of the board allows the graphics display to reside anywhere within the 32K of memory. No software modifications are required for existing software. $84.95.

Computerware, Box 668, 1472 Encinitas Blvd., Encinitas, CA 92024. (714)436-3512.

CIRCLE 302 ON READER SERVICE CARD

Memory Expansion Board for IBM PC

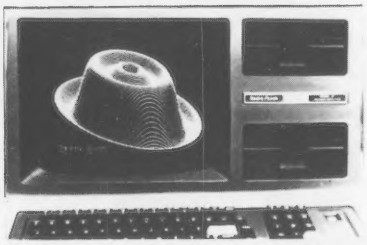
A high-capacity memory expansion board has been announced by Datamac Computer Systems. The board will allow IBM Personal Computer users to address directly up to 1MB of memory.

The board can be configured in a variety of sizes: 64K, 128K, 192K and 256K—with parity. Pricing starts at $499.

Datamac Computer Systems, 680 Almanor Ave., Sunnyvale, CA 94086. (408) 735-0323.

CIRCLE 303 ON READER SERVICE CARD

Hi-Res Graphics for TRS-80



The Grafyx Solution gives any configuration of a TRS-80 Model III computer a resolution of 512 x 192 for a total of 98,304 individually accessible points.

The included graphics package allows the user to set and reset points, lines, rectangles, and complement or clear the screen using Basic commands such as PLOT and LINE. Alternate resolution of 256 x 192, 128 x 192, or 128 x 96 are also possible.

The Grafyx Solution is an add-on circuit board which contains 12,288 bytes of additional read/write memory that does not conflict with the TRS-80 address space. $299.95.

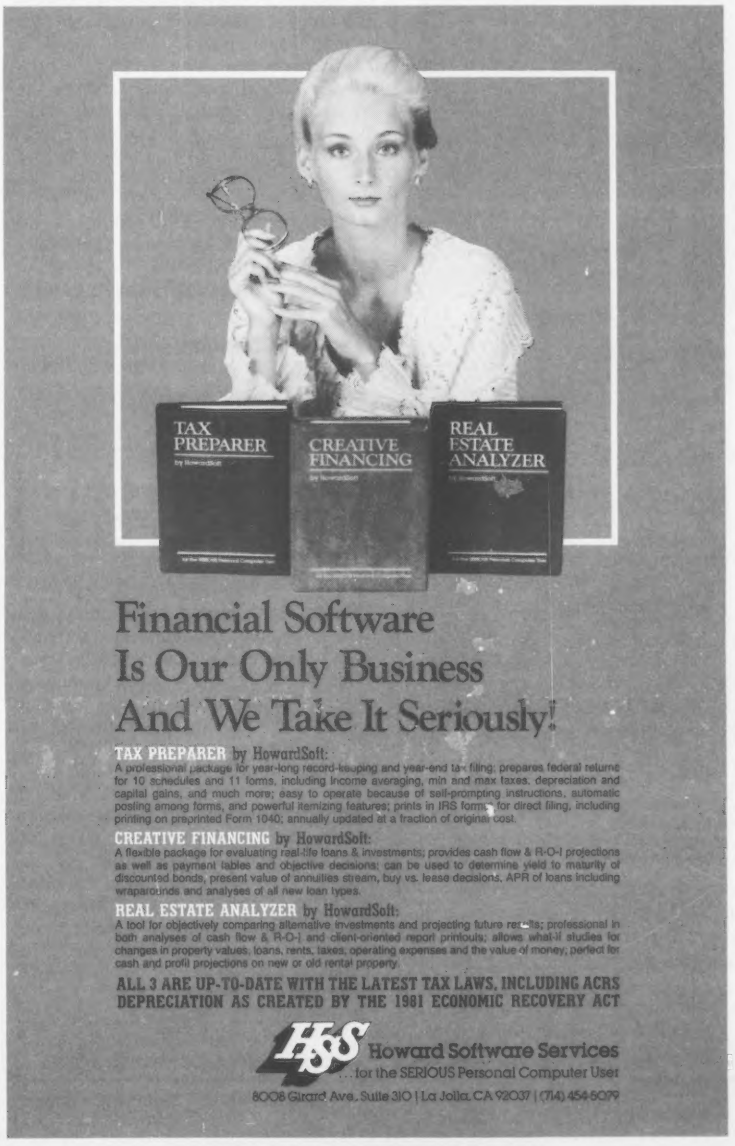
Micro-Labs, Inc., 902 Pinecrest, Richardson, TX 75080. (214) 235-0915.

CIRCLE 304 ON READER SERVICE CARD

Add-In Hardware for IBM PC

The Personal Computer Products Division of Tecmar Incorporated has announced a line of add-in and add-on hardware for the IBM Personal Computer.

The following are some of the products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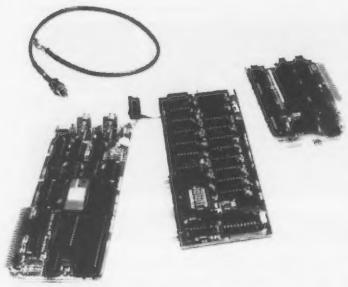
New Products, continued...

in the TecMate series: Personal Computer Expansion Chassis; System Clock with battery backup; BSR X10 Device Controller; Voice Synthesizer; Winchester Disk Drive and Controller; High Capacity (192K/256K) Dynamic Memory Board; High Speed Static Memory Board; Electrically Erasable EPROM Board; Parallel Medium Speed Input/Output Interface; Parallel High Speed Input/Output Interface; Serial Medium Speed Input/Output Interface; Serial High Speed Input/Output Interface; Multi-System Printer Sharing facility; IEEE 488 Interface; Analog to Digital Converter—8 Bit; Analog to Digital Converter—12, 14, 16 Bit; Digital to Analog Converter—12 Bit; Video Image Digitizer; Music Synthesizer; Prototyping Board; Extender Board.

Tecmar Incorporated, Personal Computer Products Division, 23600 Mercantile Rd., Cleveland, OH 44122. (216) 464-7410.

CIRCLE 305 ON READER SERVICE CARD

Apple Expansion



The Synergizer from ALS, Inc. offers Apple users CP/M compatibility, expanded RAM, 80-column display, and increased word processing software compatibility.

The Synergizer consists of an implementation of the CP/M operating system and three peripherals: Smarterm, an 80-column display board; Z-Card, the ALS Z-80A processor for the Apple which provides CP/M capabilities for both the Apple II and Apple III; and Add-Ram, the 16K RAM board that permits addressing of the full memory supported by the Z80A processor (and the 6502 in the Apple).

Retail price for the total system is $749.

ALS, 1195 E. Arques Ave., Sunnyvale, CA 94086. (408) 727-6805.

CIRCLE 306 ON READER SERVICE CARD

Personal Communication Terminal

Axlon Incorporated has announced a portable personal communication terminal for the home and business market.

The Axlon Hotline Personal Communication Terminal can be used to transmit and retrieve information from data bases.

The Hotline measures 1-5/8" x 3-9/16" x 6-3/4" and weighs less than 11 ounces.

The tactile keyboard consists of 43 functional keys arranged in typewriter sequence and provides a 64 upper case ASCII character set. The display is a 16-character fluorescent display which is tilted for easy viewing. The terminal offers a 96-character display memory, which can be scrolled 16 characters at a time, and a 16 character display in memory in the transmit mode.

Axlon Inc. 170 N. Wolfe Rd., Sunnyvale, CA 94086. (408)730-0216.

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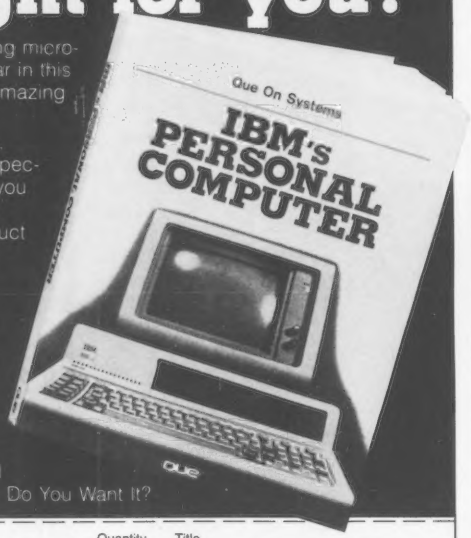

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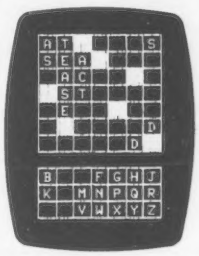
Creative Computing puts it all together for you in this new, comprehensive assemblage of product-review reprints from the magazine. It's the one convenient place to look for facts, figures and expert analysis when you're in the market for software!

The SOFTWARE BUYERS GUIDE is easy to use. Programs are listed by category for fast reference. Each evaluation has a "quick reference box" showing system requirements, format, language, price, manufacturer and a brief summary.



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- Financial and investment analysis
- Education
- Real estate and property management
- Graphic displays
- Music

- Games and recreation—simulations and strategy; fantasy, adventure, action and arcade games; intellectual recreation

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- Disk utilities
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The SOFTWARE BUYERS GUIDE also includes a Directory of Manufacturers, cross-referenced to type of computer. We put an end to the frustration of seeing a mention of a software package by "XYZ Software" and not being able to find where to buy it.

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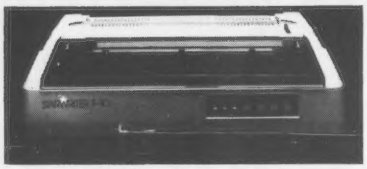
New Products, continued...

High Quality Printers

Pro-Writer is a dot matrix printer offering "professional quality printing." It includes 120 cps bidirectional printing, logic seeking and proportional spacing.

Graphics capability is built-in and includes shape and high resolution features.

The Pro-Writer also has a 1K buffer in



parallel and a 3K buffer in serial, increment printing ability, N x 9 dot matrix, and correspondence quality print in eight character sizes. Suggested retail price for the parallel model is $795 and $845 for the serial version.

Also available is the Starwriter F-10, a daisy wheel printer, which includes such features as: low profile design (6" high), industry-standard ribbon cartridges, 40 or 55 cps models, standard parallel or RS-232-C interface (including ETX/AC, X-ON/S-OFF) protocols, built-in word processing functions, plastic or metal wheels, and low noise operation.

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Accounts Receivable™	49*	200	200
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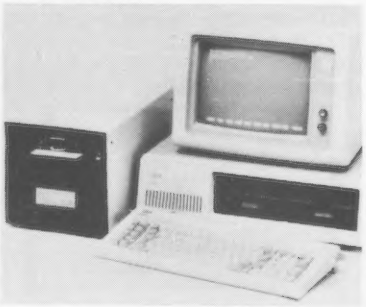
5 1/4" Winchester Disk with Backup



Santa Clara Systems, Inc. announces the introduction of MiniMega, a 5 1/4" hard disk with floppy backup, designed to work with most microcomputers.

Host adapters enable interfacing to Apple II and III, IBM Personal Computer, TRS-80, NEC PC-8000, all S-100 systems, LSI-11, Multibus, and Motorola 6800. All CP/M programs will work with machines now running CP/M.

The MiniMega is available in 5 or 10 MByte configurations alone, or integrated with a 5 1/4" 1 MByte floppy backup, packaged in a compact cabinet.

Santa Clara Systems, Inc., 560 Division St., Campbell, CA 95008. (408) 374-6972.

CIRCLE 309 ON READER SERVICE CARD

Hard Disk and CP/M for Model III

Microcomputer Technology, Inc., has announed a 5 and 7.5 MB external Winchester hard disk system for use with TRS-80 Model III computer systems.

The system uses the Micro Systems hard disk operating system version 3.3.9 which is file compatible with the TRSDOS.

The 5MB external disk drive is a self-contained unit which includes a Winchester drive, controller, power supply and cables $2799. The Micro Systems DOS plus hard disk operating system sells for $299.

Also available from MTI is the CP/M 80 board kit.

The addition of CP/M version 2.2 along with an 80-character x 24-line display allows any Model III system to run business applications packages such as Wordstar, Datastar, and Mailmerge. $849.

Microcomputer Technology, Inc., 3304 W. MacArthur Blvd., Santa Ana, CA 92704. (414)979-9925.

CIRCLE 310 ON READER SERVICE CARD

Disk Drives for Apple and TRS-80 Model II

A.M. Electronics, Incorporated announces 5 1/4" disk drives for plug-in compatibility with the Apple computer.

The add-on drives, complete with case and cable, are compatible with Apple disk operating systems, and software, and offer 40 tracks of data storage and a 3 millisecond track-to-track access time. $345.

Also available from A. M. Electronics are 8" disk drives compatible with the Radio Shack Model II computer, as well as any other computer requiring high storage disk drives.

The single-headed disk drive is capable of 1 Megabyte of storage (unformatted), while the double-headed drive is capable of 2 Megabytes (unformatted).

The drive is one-half the width of standard 8" disk drives and operated entirely from DC power. Track-to-track access time is 3 milliseconds. $695.

A. M. Electronics, Incorporated, 3366 Washtenaw Ave., Ann Arbor, MI 48104. (313) 973-2312.

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Optimized Systems Software, Inc., 10379 Lansdale Ave., Cupertino, CA 95014, (408) 446-3099

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Basic Faster and Better and Other Mysteries, by Lewis Rosenfelder. IJG Inc., 1260 W. Foothill Blvd., Upland, CA 91786. 288 pages, paperback $29.95. 1981.
Microsoft Basic Decoded and Other Mysteries, by James Farvour. IJG Inc. 312 pages, paperback $29.95. 1981.

The IJG Basic book is one of the most helpful programming books you'll ever read, if you're really into TRS-80 Basic. This is not a book of "hints and kinks" trivia, or a collection of programs for playing games or balancing your checkbook. The author presents functions and subroutines, most of which he learned the hard way, while developing business programs to sell, and is "the result of the efforts I've made to make Basic programs run better and faster," as he says in the preface.

Each routine and technique "solves one or more specific problems that you are likely to encounter when programming the TRS-80," as the preface continues.

Fifteen chapters look into areas such as Super-Power Function Calls (using DEF FN), USR Routines, Magic Memory Techniques (PEEK, POKE, active variable analyzer), Basic Overlays, Number Crunchers and Munchers, Using Strings in New Ways, Data and Time Manipulation, Bit Manipulation, Arrays, Searches and Sorts, Keyboard and Video Trickery, Data Entry Made Easy, Useful Utilities, Model 2 Modifications, and Faster and Better Disks. Eleven appendixes provide goodies such as USR Routine Pointer Addresses, Disk Buffer Memory Locations, and Disk DCB Addresses, along with the usual decimal-to-hex and graphics-character tables.

This book isn't for everyone; it is heavy reading that goes far beyond the usual collections of programs and routines. But if you write business programs, or just want to know how to write highly efficient Basic programs, get this book. A pair of disks were scheduled to be available in the first quarter of 1982, one containing all the demonstration programs, the other all the library functions, at $19.95 each.

The book on Microsoft Basic is a detailed, annotated guide to the operating system and Basic interpreter in the TRS-80 Level-II ROM, and is a must for all ROMniks.

The first fifth of the book contains six chapters: Introduction, Subroutines, Cassette and Disk, Addresses and Tables, etc. The rest, 150 pages, consists of detailed listings of the ROM memory locations, 62 lines per right-hand page, with over 7,000 comments that often wrap around to the next left-hand page. The 62-line format exactly matches the Apparat disassembler's format; the pages are hole-punched for a three-ring binder, so you can line up the disassembler's output with the comments.

The introduction provides a wealth of information about the ROM and Level-II operation. The subroutine chapter is fascinating, with the entry points of dozens of calls (the more general ones), a brief description of each, and the disassembled listings, with comments.

The IJG books aren't for everyone, but if you want to know what is going on in the TRS-80 ROM, this one is a goldmine, as is the Rosenfelder book for those who want "a guided tour of Basic programming tricks and techniques."

Encyclopedia for the TRS-80, edited by Kate Comiskey, Chris Crocket, et al. Wayne Green Books, Peterborough, NH. Ten volumes, approximately 280 to 300 pages each. Hardcover, $19.95 each, $164 the set; paperback $10.95 each, $83 the set. 1981-1982.
Encyclopedia Loader: Programs on cassette from Encyclopedia for the TRS-80. Vol. 1, $12.95; Vol. 2-10, $14.95 each.

According to the advertisements, this encyclopedia "will never become stale or out of date. That's because the volumes...are being issued one-at-a-time, approximately six weeks apart. This means that each new volume will reflect the latest developments and discoveries.... The first four volumes are being issued during 1981. The remaining volumes will be issued during the first half of 1982."

Each of the first three volumes seen includes articles in nine categories: business, education, games, graphics, hardware, home applications, interface, tutorial, and utility.

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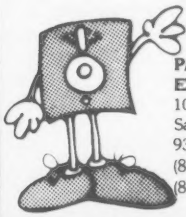

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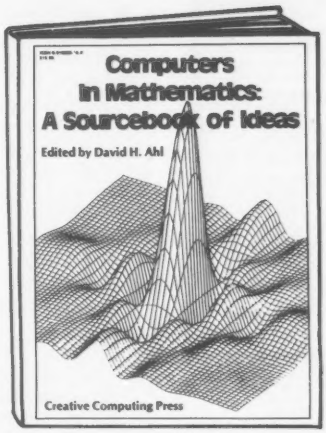

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Another section presents over 250 problems, puzzles, and programming ideas, more than are found in most "problem collection" books.

Computers in Mathematics: A Sourcebook of Ideas is edited by David Ahl, one of the pioneers in computer education and the founder of *Creative Computing.*

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create delay loops. Hardware articles show how to read/write on both sides of your floppy disks, protect your cassette relay, operate a radio-controlled model car with a radio link, and calibrate your printer. Tutorials discuss TTY interfaces and introductory TRS-80 programming. The companion *Encyclopedia Loader* cassette includes all but one of the 16 programs in Volume 1.

Volumes 2 and 3 are similar in scope, with programs for a name-and-address file, expense report, *Keno*, curve plotting, word processing, decoding Morse, tutoring algebra, and articles on building a light pen, regulating your video monitor, building a Deluxe Expansion Interface, etc.

As with any encyclopedia, many of the programs, construction articles and tutorials in these pages may seldom if ever be used, but they're all there if and when you need them, all written simply for easy reading. On the other hand, $164 or even $83 may seem like a lot of money to a TRS-80 user who may not find many of the pages immediately relevant (even though they do make for good browsing). It's a safe bet to predict this encyclopedia will be selling, by mid-1983 (if not before), for about two-thirds or even half the advertised prices, which seems about right.

Exploring Computing with the TRS-80 (and common sense) with programming in Basic, by Richard V. Andree and Josephine P. Andree. Prentice-Hall Inc., Englewood Cliffs, NJ. 240 pages, hardcover $15.95. 1982.

Winner of the Thanatos award for the longest book title, this typewritten book is in two parts. The first 102 pages teach "what you need to know to use your computer in solving real problems," with five lessons on tables, computer-assisted solutions, art and graphics.

Part II is "devoted to special topics you may or may not need to learn about, depending upon your own particular interests. Lessons 6 to 17 may be read in any order, or ignored entirely until needed." These twelve lessons cover tape, games, editing, simulation, variables, error messages, more graphics, strings and logical operators, etc.

views...book

Although the cover shows a TRS-80 Model III, this is misleading. The book isn't about Model III Basic, or even Microsoft Basic. Page vii says "Most of the instructions used in this book work on all versions of Basic." However, a chart at the back of the book shows which instructions work on which of the "eight most common versions of the TRS-80," including tape and disk, Models I, II and III, Color Computer and Pocket Computer.

The authors teach at the University of Oklahoma, and the book shows a lot of careful preparation, with a slow and steady introduction of Basic, covering all the details and building on previous material.

However, not only is the text typewritten, but all the artwork is done by hand, including the small rectangles around ENTER and the larger CRT-type rectangles around display material. These are not done well, and make the book look like a manuscript. For $15.95, the reader deserves a book that is easier on the eyes, regardless of its merit. Although a typeset text means a shorter publication time, and puts the burden of proofreading upon the authors, this book is not a credit to the Andrees or to Prentice-Hall.

Computer Programs in Basic, by Paul Friedman. Prentice-Hall Inc., Englewood Cliffs, NJ. 285 pages, hardcover $19.95, paperback $10.95. 1981.

What a surprise to open this book and find not a single program in it. Then you read the small print at the bottom of the dust jacket's cover: "The software resource guide to programs for business/finance-games-mathematics-science/education."

What we have here is a "fully indexed guide to over 1,600 Basic computer programs recently published in easily accessed personal computer magazines," according to the jacket flap, which adds two more "major discipline fields" to the four in the subtitle: personal interest and utility.

Most of the 259 pages consist of listings with the program's name, author, source, brief description, number of lines, the version of Basic used, special hardware and non-Basic software required, and non-ANSI features of the program, if any.

The 8-page introduction tells how to use the book, how to get the programs (subscribe to at least three magazines, check your local computer club, check back-issue ads, buy microfilmed issues), translating other-computer programs for your own machine, and "Pitfalls in Basic."

Appendix A lists four pages of Basic statements and functions. Appendix B gives the names, addresses and some details about the ten periodicals reviewed. A five-page glossary ends the book, although it seems that anybody who would buy such a book wouldn't need the glossary.

An interesting book containing many useful references, this is hardly worth buying in hardcover, since it was out of date long before publication; the most recent program was published in Dec. 1979; the book itself was published April 30, 1981.

Computing in the Humanities, edited by Peter C. Patton and Renee A. Holoien. Lexington Books, D.C. Heath and Co., Lexington, MA. 413 pages, hardcover $29.95. 1981.

The eleventh in the Lexington Book Series in Computer Science, this is a collection of two dozen papers by professors, lecturers, graduate students and graduates of the University of Minnesota.

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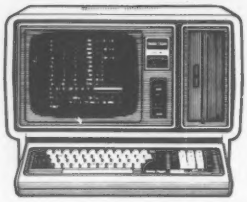

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The book began several years ago with a survey, carried out on a summer research grant, of faculty members in every department of the university's College of Liberal Arts that indicated interest in computing.

The chapters involve the use of computers in four areas: analysis of language and literature (Greek New Testament text, analysis of literary style, concordances of troubadour poetry, etc.), archeology and history (database for Babylonian economic documents, simulation of a Roman wine and oil plantation, CAI in archeology, etc.), humanistic education (computer-based course in ancient Egyptian hieroglyphics, CAI courses in Sumerian and Latin, etc.), and the fine arts (five artists, including Ruth Leavitt).

A few of the papers are on subjects so specialized as to be of interest mainly to colleagues; the majority provide fascinating glimpses into the many uses of computers in liberal arts. For readers who wish to delve further, references and bibliographies are provided.

---

55 Color Computer Programs For The Home, School and Office, by Ron Clark. ARCsoft Publishers, Box 132, Woodsboro, MD 21798. 128 pages, paperback $9.95 (shipping $1). 1981.
101 Color Computer Programming Tips and Tricks, by Ron Clark. ARCsoft Publishers. 128 pages, paperback $7.95. 1981.
50 Programs in Basic For The Home, School and Office for the Pocket Computer, by Jim Cole. ARCsoft Publishers. 96 pages, paperback $9.95. Second edition, 1981.
101 Pocket Computer Programming Tips and Tricks, by Jim Cole. ARCsoft Publishers. 128 pages, paperback $7.95. 1981.

These four slim volumes, dedicated to the Radio Shack Color Computer and Pocket Computer, provide dozens of programs a reader may occasionally need, plus a hundred interesting and largely usable short programs.

55 Color Computer Programs contains programs in six categories, including: business (invoicing, wages, markup, salesman's commission, bar chart), school (state capitals, hex chart, math flasher, Canadian provinces), teachers (evaluating exam scores, class roll sorter), music (musical scale test, keyboard music player), home (electric-bill analysis, digital stopwatch, draw straws, dice), graphics (kaleidoscope, sketch pad, blinking man). A four-page appendix lists Color Basic functions, statements, operators, video control codes, graphic-character codes, control keys, special characters and error messages.

Some of the business programs are rudimentary, such as *Wages*, which is 18 lines long. However, many are usable in small businesses, either as is, or tailored to the application. The remaining programs (outside of those for teachers) are more for the beginning computerist; many are interesting and informative.

101 Color Computer Programming Tips and Tricks is a much more valuable book for the computernik, with six types of programs, such as: graphics (dancing spot, painting exercises, lettering graphics, erasing numbers, how to graph), music (sound with graphics, music test, R2D2 sound effects), text (custom cursor, letter repeater, last name first, bubble sort, search and order), fun and games (digging a tunnel, striped titles, rainbow billboard), number crunching (commas in numbers, stringy numbers, random sampler, VAL), odds and ends (memory peek, character search, seconds timer, IF/THEN/ELSE). There's a great deal of useful information here, all sorts of "hints,

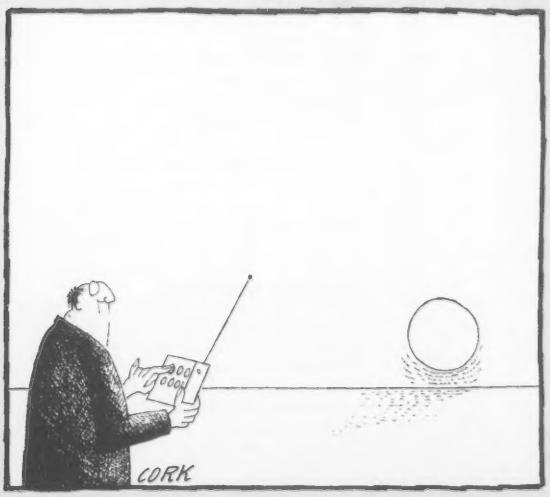
secrets, shortcuts, and color techniques," as the cover puts it. Many of the programs, which range from three to several dozen lines in length, are useful as is, or can be used as subroutines. Many use Basic statements unique to the Color Computer, such as CIRCLE, COLOR, DRAW, PAINT, PLAY, etc., and thus help the user understand them more fully.

50 Programs in Basic for the Pocket Computer contains programs of three types, including: business (pocket datebook, making change, advertising cost-per-thousand, plus several similar to those in the Color Computer book), education (slope and distance, dB, metric converter, factors, averages), home (simple and compound interest, mortgage loan, *Klingon Killer*, craps). These 50 programs seem a little more practical than the 55 Color Computer programs, and all can, with minor modifications, be used on any Basic microcomputer.

101 Pocket Computer Programming Tips and Tricks is, once again, more likely to be of interest to the bit-hacker than the *50 Programs* book, with seven categories of short programs, including these: fun and games (flashing billboards, one-time password, secret code, controlled beeping), printer (tables, list of names, English strings, spacing numbers), memories (quick load, cleansing variables, dividing variables, comparing strings), random numbers (varying the digits, sneaky seeds, random random), changing numbers (truncating numbers, dump the integer, fractional feet, print mixing), finding numbers (highest and lowest, averages, roots, standard deviation), running (timing loops, GOSUB, label jumps, clean layout).

These 307 programs provide many hours of material for learning more about Basic and the Color and Pocket Computers, and for using either as written or amplified by the reader, or as routines in longer programs. Some are trivial, others are complicated, but none are beyond anyone willing to key them in (no tapes are available) and figure them out (explanations are minimal; REM lines are nonexistent and not often needed anyway).

ARCsoft also publishes a book of *50 More Programs for the Home, School and Office* for the Pocket Computer, at $9.95. All the programs will also run on the Sharp PC-12ll, which is the same machine as the Pocket Computer, but bearing the label of the manufacturer, Sharp Electronics Corporation. □



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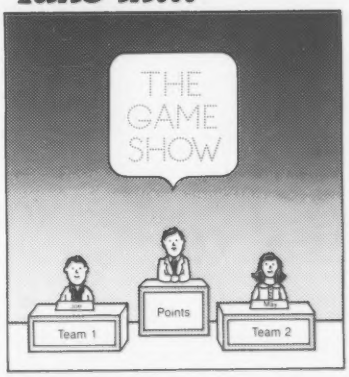

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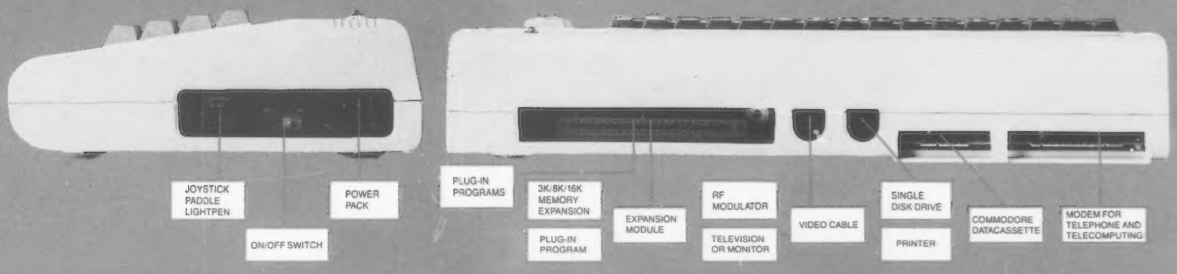

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